Appendix F

Turlock Groundwater Management Plan

CITY OF CERES

Turlock Groundwater Basin
Stanislaus and Merced Counties, California

DRAFT TURLOCK GROUNDWATER BASIN GROUNDWATER MANAGEMENT PLAN

UNDER CALIFORNIA STATE WATER CODE SECTIONS 10750 ET SEQ. (AB 3030)

August 1997

TURLOCK GROUNDWATER BASIN

DRAFT GROUNDWATER MANAGEMENT PLAN

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I. INTRODUCTION

A. LEGAL AUTHORITY UNDER AB 3030

The Groundwater Management Act (AB 3030) was passed by the State legislature during the 1992 session, and became law on January 1, 1993. The Groundwater Management Act, as codified in California Water Code sections 10750 *et seq.*, identifies groundwater as a valuable resource that should be managed to ensure both its safe production and its quality. AB 3030 also encourages local agencies to work cooperatively to manage groundwater resources within their jurisdiction.

The act applies to all groundwater basins identified in the Department of Water Resources (DWR) Bulletin 118 (dated September 1975), except those already subject to groundwater management by a local agency or watermaster pursuant to other law, court order, judgment or decree, unless the local agency or watermaster agrees. Bulletin 118 specifically identifies the Turlock Groundwater Basin making it eligible for groundwater management under AB 3030.

The law provides that any district or other political subdivision of the state which is authorized to provide water service and is exercising that authority, may by ordinance or resolution adopt and implement a groundwater management plan within all or a portion of its service area. The law also indicates that a local public agency that provides flood control, groundwater management, groundwater replenishment, or a local agency, formed pursuant to the Water Code for the principal purpose of providing water service, that has not yet provided that service, may establish an AB 3030 groundwater management plan within its boundaries provided that those areas are not served by another local agency.

The act also authorizes a local public agency to exercise the specified powers of a water replenishment district, subject to the approval of the voters within the agency's service area.

B. DEFINITION OF GROUNDWATER MANAGEMENT

The California Department of Water Resources Bulletin 118-80 defines a "groundwater management plan" as "planned use of the groundwater basin yield, storage space, transmission capability, and water storage." A "groundwater management program," as defined by the Water Code section 10752(e), is a coordinated and ongoing activity undertaken for the benefit of a groundwater basin pursuant to a groundwater management plan adopted as specified in AB 3030.

C. GROUNDWATER MANAGEMENT WITHIN THE TURLOCK GROUNDWATER BASIN

Certain agencies within the Turlock Groundwater Basin, following their public hearings, have adopted Resolutions of Intention to Adopt a Groundwater Management Plan pursuant to Water Code section 10753 *et seq.* (See Appendix F). In addition, the agencies have adopted a Memorandum of Understanding (See Appendix E) creating the Turlock Groundwater Basin Association ("TGBA"), for the purpose of developing a basin-wide groundwater management plan. Based on the foregoing, the TGBA undertakes this groundwater management plan to guide the management of the groundwater resources within the Turlock Groundwater Basin.

II. GOALS

A. GOALS OF THE ASSOCIATION

The agencies within the TGBA agree that the groundwater and surface water resources within the Turlock Groundwater Basin are vitally important resources that provide the foundation for maintaining current and fulfilling future environmental, agricultural, domestic, municipal and industrial needs, as well as other needs, and to maintain the economic viability and prosperity of the Basin area.

The goals of the TGBA, as set forth in the MOU establishing the Association, are as follows:

1. To determine the extent and evaluate quantity and quality of the Basin's existing groundwater supplies;
2. Consider developing and/or utilizing an existing hydrologic groundwater model of the Basin's groundwater supplies;
3. Determine the Basin's need for additional or improved water extraction, storage, delivery, conservation, reuse and recharge facilities;
4. Provide information and guidance for the management, preservation, protection and enhancement of the Basin;
5. Provide a way to maintain local control of our water resources;
6. Promote coordinated planning to make the best use of available water resources to meet the needs of the association's respective constituents and service territories in the mutual best interests of the inhabitants and resources of the Basin; and
7. Prepare and promote a draft groundwater management plan for the Basin, which could be adopted by the appropriate local agency or agencies.

B. GOAL OF THE BASIN-WIDE GROUNDWATER MANAGEMENT PLAN

The goal of the groundwater management plan is to implement sound groundwater management practices, in order to maintain the available groundwater resources to meet the beneficial uses and needs of the Turlock Groundwater Basin. The groundwater management plan includes sound principles of groundwater optimization which include, but are not limited to, the following:

1. Protection and planned maintenance of groundwater quality;

2. Protection and beneficial use of recharge areas; and

3. Monitoring of Basin parameters for the primary purpose of maintaining groundwater quantities and eliminating conditions of long-term overdraft.

The groundwater management plan will also document existing groundwater management activities and practices.

III. DESCRIPTION OF THE BASIN

A. GEOGRAPHICAL DESCRIPTION OF THE BASIN

The Turlock Groundwater Basin lies on the eastern side of the San Joaquin Valley, and encompasses portions of both Stanislaus and Merced counties. The groundwater system is bounded by the Tuolumne River on the north, the Merced River on the south, and the San Joaquin River on the west, as shown in Figure 1. The eastern boundary of the system is the western extent of the outcrop of low-permeability Valley Springs formation rocks in the foothills of the Sierra Nevada.

B. GEOLOGICAL DESCRIPTION OF THE BASIN

Groundwater within the Basin occurs under unconfined and confined conditions. A portion of the Basin is underlain by the Corcoran clay which separates the groundwater into two zones; an upper, unconfined aquifer and a lower, confined aquifer (see Figure 2). There is also a deeply buried confined aquifer containing saline brine extending into the unconsolidated sediments. The presumed origin of the saline brine is the connate water sourced with the Upper Cretaceous marine shales that underlie the Pleistocene and Holocene sediments.

1. Unconfined Aquifer

An unconfined aquifer is an aquifer in which the groundwater is not under pressure. In the Turlock Groundwater Basin, the unconfined aquifer occurs in unconsolidated deposits above and east of the Corcoran clay. In the area underlain by the Corcoran clay, the top of the clay is the base of the aquifer. To the east of the clay, the top of the consolidated rocks is the base of the aquifer. Above and to the east of the Corcoran clay, the top of the unconfined aquifer is the water table. The unconfined aquifer has areas which are locally confined by clay layers that are not continuous over long distances.

The general direction of regional groundwater flow in the unconfined aquifer is westward and southward towards the valley trough (see Figure 3). The direction of groundwater flow is controlled by the elevations of the Tuolumne, Merced and San Joaquin Rivers. The elevation of the water table is maintained along these rivers at the local elevation of the water surface within the river. Groundwater levels are maintained by exchanges of water between the river and the groundwater system.

2. Freshwater Confined Aquifer

A confined aquifer is an aquifer in which the groundwater is contained under pressure. The confined aquifer within the Turlock Groundwater Basin occurs in the unconsolidated deposits that underlie the Corcoran clay. Accordingly, the areal extent of the confined aquifer is limited to the areal extent of the Corcoran clay. The top of the consolidated rocks is the base of the unconsolidated deposits. The top of the confined aquifer is the bottom of the Corcoran clay. Not much information is known about the confined aquifer because so few wells are completed only on the confined aquifer.

Based on general hydrologic considerations, the direction of groundwater flow in the confined aquifer is probably similar to that in the unconfined aquifer, westward and southward. Under historical conditions, the hydraulic head in the confined aquifer was greater than that of the unconfined aquifer, which caused water to flow upwards through the Corcoran clay from the confined to the unconfined system. Under present conditions, the pumping that has occurred in the unconfined aquifer would tend to maintain an increase in the upward gradient (head differential) between the aquifers. However, because of the lack of information on the conditions in the confined aquifer, an upward gradient across the Corcoran clay cannot be confirmed.

3. Saline Confined Aquifer

Fresh groundwater in the San Joaquin Valley is underlain by a saline brine groundwater body. These saline brines are contained in confined aquifers in the deeply buried marine sandstones and shales which underlie the valley. Some gas exploration wells were drilled into the deep marine rocks along the Tuolumne River near Waterford and Ceres. The wells were artesian, flowing wells which produced saline brines without pumping for many years, until they were plugged in the 1970's. The artesian conditions indicate that the deep, saline groundwater is under sufficient hydraulic head (pressure) to push water up to the land surface. This head will cause the saline water to migrate upwards where movement is possible. This upwelling can occur in wells, as well as along cracks, fissures, and faults. Saline brines are migrating upward and mix with the shallow fresh groundwaters to form high total dissolved-solids (TDS) groundwater at a certain depth below the surface. The base of the fresh water is extremely variable and often occurs in the unconsolidated sediments.

The deep, saline groundwater flows, as does all the groundwater in the valley, from the valley's sides towards its trough. Upwelling occurs at the trough where the flows from the opposite sides of the valley meet, and the only direction for the water to go is up. On the surface, the San Joaquin River occupies the valley trough. Water for the river flow is derived in the same way. Groundwater flows from the opposite sides of the valley meet and move upwards providing water to the river.

C. LOCAL AGENCIES WITHIN THE GROUNDWATER BASIN

The Basin includes the following local agencies eligible to participate in an AB 3030 groundwater management plan: the Turlock and Merced irrigation districts; the cities of Ceres, Turlock and Hughson; the Hilmar and Delhi county water districts; the Keyes, Denair and Ballico community services districts; the Eastside and Ballico-Cortez water districts; the City of Modesto; as well as Stanislaus and Merced counties.

At this time, it is understood that each local water agency may adopt the groundwater management plan to manage groundwater resources within their jurisdiction. If a county adopts a groundwater management plan, the plan shall apply to those areas lying outside the other agencies' boundaries which have adopted groundwater management plans.

IV. GROUNDWATER BASIN CONDITIONS

A. WATER SUPPLY

1. Precipitation

Within the Basin, precipitation alone does not satisfy urban and agricultural water supply requirements. The amount of precipitation in this part of the valley varies widely from year to year. The average annual precipitation based on a forty (40) year average for the Basin is 11.08 inches. Since the majority of precipitation falls in the winter, most landscaping, crops and orchards are dependent upon irrigation during the growing season. While the precipitation does not fully satisfy water demands, it does contribute to groundwater recharge (see Figure 4). Therefore, the groundwater system contains some portion of water that originated from the direct infiltration of precipitation.

2. Surface Water

The Turlock Irrigation District and the Merced Irrigation District are the only entities within the Basin with access to firm supplies of developed surface water. During wet years, at the discretion of the Turlock and Merced irrigation districts, irrigators outside the districts boundaries, but situated along the districts canals, are offered surface water. In addition, there are some individual property owners, with riparian rights that utilize water from the bordering rivers. The extent of this type of usage is undocumented.

The Turlock Irrigation District's main source of water is through surface water diversions from the Tuolumne River. TID and the Modesto Irrigation District jointly operate the Don Pedro Reservoir on the Tuolumne River to store winter and spring runoff for agricultural and municipal uses. The surface water available to growers within TID is based on the runoff each year coupled with its share of carry-over storage from Don Pedro.

The Merced Irrigation District's main source of surface water is the Merced River. Merced ID operates Lake McClure to store winter and spring runoff for summer irrigation. The surface water available to Merced ID each year is based on the runoff for that year coupled with the Merced ID's direct diversion rights and stored water from Lake McClure.

Within the Basin, surface water supplies an average of fifty-three percent (53%) of the total irrigation water applied to land within the districts, or approximately 470,000 acre-feet per year. A significant part of applied irrigation water percolates past the root zone to become community services districts; the Eastside and Ballico-Cortez water districts; the City of Modesto; as well as Stanislaus and Merced counties.

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Within the Basin, surface water supplies an average of fifty-three percent (53%) of the total irrigation water applied to land within the districts, or approximately 470,000 acre-feet per year. A significant part of applied irrigation water percolates past the root zone to become groundwater recharge. The effect of the deep percolation of applied surface water on groundwater recharge is illustrated on Figure 10 (Inflows and Outflows to Groundwater Basin). Therefore, a majority of water in the Basin groundwater system originated from the Tuolumne River, and to a much lesser extent the Merced River.

3. Groundwater

The Turlock Irrigation District supplements its surface water supply with groundwater to satisfy crop-water requirements, the extent of which varies from year to year depending on the availability of surface water. The TID pumps groundwater directly into canals from both TID owned drainage wells and rented wells for distribution to users within its irrigation service area. In addition, some individual growers within the District pump groundwater to supplement their surface water allotments, while others use groundwater to meet their entire crop-water requirement.

Like the Turlock Irrigation District, the Merced Irrigation District supplements its surface water supply with groundwater to satisfy crop-water requirements, the extent of which varies from year to year depending on the availability of surface water. The Merced ID pumps groundwater directly into canals, laterals and pipelines exclusively from Merced ID-owned irrigation and drainage wells. All of Merced Irrigation District's wells are located outside the area of the Turlock Groundwater Basin. Even so, the District incorporates pumped groundwater into its' total supply and makes deliveries to lands in the area of the Turlock Groundwater Basin on the same basis as it delivers to other lands within its' District boundaries. Only in severe drought conditions does the Merced ID permit the discharge and wheeling of groundwater from privately owned wells into the Merced ID's water conveyance system. In some areas of Merced ID, growers meet their crop-water requirements from their own groundwater supplies.

Eastside and Ballico-Cortez water districts have limited access to surface water supplies for irrigation purposes, and rely upon the groundwater to supply their crop-water requirements. Within these districts there are individual properties with access to occasional surface water deliveries from either Turlock or Merced irrigation districts. This type of water is not available on a consistent basis, being dependent upon both surface water availability and system capacity constraints. Therefore, due to the unreliability of this type of water, it is appropriate to assume that the growers within the Eastside and Ballico-Cortez water districts must rely on groundwater to supply their crop-water requirements.

There are agricultural areas located outside of the local water agency boundaries which are thought to also utilize groundwater to irrigate their crops. There is a fairly large area located on the eastern boundary of the Basin, for example, which could potentially be developed into agricultural farm land. It is unknown at this time the exact extent of the current or planned agricultural development and water usage in these areas.

The total annual application of groundwater for irrigation purposes varies from year to year depending on the availability of surface water. Groundwater supplies an average of forty-seven percent (47%) of the total irrigation water applied to land within the districts, or approximately 411,000 acre-feet per year. The deep percolation of extracted groundwater used for irrigation returns a portion of the extracted groundwater to the aquifer. Therefore the groundwater system contains some portion of recycled groundwater.

Presently, municipal, industrial and individual domestic water users rely solely on groundwater. While the supply has been adequate, the groundwater quality has deteriorated in some areas to the point where treatment is required to make it suitable for these uses.

Groundwater conditions within the Basin vary. Levels in the eastern areas are in a significant state of decline. Levels in the western areas of the Basin are high to the point of requiring pumping in certain areas to keep the groundwater from encroaching into the root zone of agricultural crops. These trends are demonstrated in Figures 5 through 9 which show contours of groundwater elevations over a period of 20 years. The general accretions to and depletions of the groundwater basin, shown on Figure 10 entitled "Inflows and Outflows to Groundwater Basin," result in a local annual overdraft ranging from 70,000 to 85,000 acre-feet. The localized overdraft is occurring mainly in the eastern areas of the Basin which lack a surface water supply component.

4. <u>Reclamation</u>

The major municipal water suppliers in the Basin, in the course of disposing treated effluent, are in the practice of reclaiming water for either reuse or recharge. Table 5 illustrates the various methods of treated effluent reuse, recharge and disposal within the Basin. Municipalities annually deliver approximately 13,000 acre-feet of treated waste water to irrigators thus reducing surface and/or groundwater demands. In addition, TID's Almond Power Plant uses approximately 92 acre-feet of treated effluent per year from the City of Ceres. The District further treats the water which is used for steam production. Approximately fifty percent (50%) of this water is later returned to the city's percolation ponds. Overall, approximately 3,792 acre-feet of municipally treated waste water is deposited annually into percolation ponds. Therefore, the groundwater system contains some portion of recycled water.

B. WATER DEMAND/USAGE

1. <u>Agricultural</u>

a. Historical Usage

Agricultural land within the districts uses an average of 881,000 acre-feet per year. On the average the total crop-water requirement is comprised of approximately forty-seven percent (47%), or 411,000 acre-feet of groundwater, and approximately fifty-three percent (53%), or 470,000 acre-feet of surface water. Table 1, attached, summarizes historical surface and groundwater usage.

The Turlock Irrigation District uses surface water and groundwater supplies conjunctively to supply the agricultural irrigation requirements. The TID on the average supplies approximately 541,000 acre-feet (including deep percolation and system losses) per year to irrigation customers. Surface water supplies an average of eighty percent (80%) of the total deliveries, or approximately 435,000 acre-feet per year. In addition, it is estimated that the individual growers within the TID pump an average of 123,000 acre-feet per year.

The average annual agricultural usage within the Merced Irrigation District is approximately 312,000 acre-feet. Surface water supplies an average of ninety-six percent (96%) of the total deliveries, or approximately 300,000 acre-feet per year. The average annual agricultural usage within that portion of the Merced Irrigation District overlying the Turlock Groundwater Basin is approximately 22,000 acre-feet. In addition, some individual growers within the Merced ID meet their crop-water requirement from their own groundwater supplies. The extent of this type of pumping is unknown at this time.

With the exception of minor amounts of surface water made available from Turlock and Merced irrigation districts in wet years, irrigators within the Eastside and Ballico-Cortez water districts rely on groundwater to supply irrigation water. The Eastside Water District's irrigation requirement is estimated to be 155,000 acre-feet per year. The Ballico-Cortez Water District's irrigation requirement is estimated to be 27,000 acre-feet per year.

The agricultural areas located outside of the local water agency boundaries are thought to utilize groundwater to irrigate their crops. It is unknown at this time the exact extent of the agricultural development or water usage in these areas.

In addition, a small portion of the agricultural land within the Basin utilizes municipal waste water effluent to irrigate. The majority of the water is used to irrigate barley and oat crops, as well as pasture land. This reclaimed water originated from a combination municipal groundwater pumping and surface water. The City of Modesto, which supplies the majority of the reclaimed water currently used for irrigation purposes, utilizes a combination of groundwater and surface water to supply their customers. In addition, the City of Modesto's waste water treatment facilities treats the sewage effluent from those areas north and south of the Tuolumne River. Therefore, a portion of the reclaimed water from the City of Modesto originated from the Tuolumne River, as well as groundwater pumping both north and south of the river.

b. Projected Water Demands

For the foreseeable future, it is anticipated that cropping patterns and related irrigation requirements, on a per acre basis, will remain essentially the same. Furthermore, if no appreciable amount of additional lands are brought into agricultural production, it is estimated that agricultural water demand will decrease as municipal/industrial development gradually encroaches upon agricultural lands.

Storage Reservoirs on both the Tuolumne and Merced rivers operate under permits issued by the Federal Energy Regulatory Commission (FERC). The FERC requires, as a condition of the permits, that certain releases be made from both reservoirs to maintain downstream fish habitats. Any increase in FERC release requirements will result in a decreased amount of surface water available to either

Merced or Turlock ID irrigators, and a correspondingly increased reliance upon groundwater supplies to supplement surface water shortages. Any additional flows required by other regulatory agencies will also affect the surface water available for irrigation and impact reliance upon groundwater resources.

c. *Irrigation Practices*

There are a variety of irrigation methods available. The Basin's agricultural community uses a combination of flood, drip and sprinkler irrigation methods. The flood irrigation method provides the necessary crop-water requirements, while a portion of the water percolates down to recharge the groundwater basin. Other methods are available, such as drip and sprinkler irrigation systems, designed to provide better water-use efficiency. As a result, these alternative irrigation methods, when compared to flood irrigation, the alternative irrigation methods provide increased efficiency and decreased groundwater recharge.

Historically, when farms converted from flood to drip irrigation systems they typically converted from surface to groundwater usage, creating an increased demand on groundwater supplies. The TID is working with property owners within their service area to help develop ways of effectively utilizing surface water to drip irrigate in an effort to minimize potentially adverse impacts to the groundwater system.

Irrigators within the Turlock and Merced irrigation districts have historically used flood irrigation methods. Land within each of these Districts is being transferred to both drip and sprinkler irrigation each year. However, irrigators within the Eastside and Ballico-Cortez water districts, which rely on groundwater as their water source, predominantly use both drip and sprinkler irrigation methods.

2. Municipal/Industrial

a. *Historical Usage*

Historically, municipal consumers within the Basin have relied solely on groundwater as the source of supply. The municipal suppliers (major utilities) within the Basin are: the cities of Turlock, Modesto, Ceres and Hughson; the Hilmar and Delhi county water districts; and the Denair and Keyes community services districts. The total water produced by these major water utilities in 1995 was 36,200 acre-feet (32.5 MGD), supplied entirely through groundwater pumping. An additional estimated 10,900 acre-feet per year (9.7 MGD) is produced by small private residential water systems, commercial businesses and industrial plants not served by the major utilities.

There are many industrial users within the Basin. The majority of industries using large amounts of water are related to agriculture, including milk processing, poultry plants and canneries. The vast majority of the industrial water is currently supplied by the municipal agencies. However, a few industries do rely on their own water wells as a source of supply. For planning purposes, their overall impact on the local groundwater supply is assumed to be minimal.

Ninety-one percent (91%) of the 36,200 acre-feet (32.5 MGD) of water produced by the major utilities in 1995 was concentrated in two areas along State Highway 99; South Modesto/Ceres/Keyes and the Turlock/Delhi areas. This represents seventy percent (70%) of the municipal water pumped within the Basin. The City of Turlock is the largest water producer with thirty-eight percent (38%) of the total. Water usage increased by nine percent (9%) between 1990 and 1995. Figure 11 shows the historical groundwater usage for the various municipal agencies.

Water use varies dramatically on a seasonal basis. Table 3 presents the typical monthly flow distribution expected for this area. Water use on a hot summer day is approximately four times that of a winter day. Maximum demands for water occur in June, July and August because the hot, dry weather creates a substantial demand for landscape irrigation.

b. Projected Water Demands

The population and developed municipal acreage are projected to triple by the year 2030. Using current population trends within the Basin's communities (projecting a 3.6% increase per year), the population within the municipalities is expected to increase from 119,000 in 1995 to over 400,000 by 2030 with developed acreage increasing proportionately. As a result, the average daily water usage in these communities is expected to increase from 32.5 MGD (32,600 acre-feet) in 1995 to over 97.1 MGD (108,800 acre-feet) in the year 2030. In addition, the majority of municipal/industrial demand is projected to be concentrated along the Highway 99 corridor. If groundwater remains the sole source of municipal supply, it is estimated that 205 wells will be required. Table 4 shows the projected annual water demand for the eight municipalities through the year 2030.

c. Water Conservation

Additional water conservation efforts in the future are expected to reduce the current per capita water usage. There is currently a wide variance in water consumption among the various agencies and additional water conservation savings is expected to be greater for those agencies with the highest consumption. For the projected water demand (discussed above and shown in Table 4) water conservation savings were factored in over time with a total reduction of 10% for agencies with a low per capita usage and 15% for the rest.

3. <u>Summary of Basin Water Demand/Usage</u>

As municipal/industrial development encroaches on agricultural lands within the Basin, it is anticipated that the use of water will also change. It is estimated that water use by the municipal utilities will increase from 36,200 AF/YR (32.5 MGD) in 1995 to over 108,800 AF/YR (97.1 MGD) by 2030, while agricultural use is projected to decrease as irrigated agricultural land is converted to municipal use.

In anticipation of the projected increased demand for municipal water supplies and as a means of addressing water quality issues of groundwater, the Turlock Irrigation District and the municipal suppliers are investigating the feasibility of constructing a water treatment plant (or plants) to treat surface water, supplied by TID, to be used for municipal purposes. However, because the decrease in agricultural demand will be almost wholly matched by the increase in municipal demand, the proposed drinking water supply program would not resolve the existing groundwater basin overdraft of 70,000 to 85,000 AF/YR.

C. WATER BALANCE/SAFE YIELD

Safe yield of an aquifer is defined as the amount of water that can be withdrawn annually without producing a permanent, undesired result such as groundwater overdraft, quality degradation and declines in river levels or discharge rates to wetlands resulting from increased pumping for the groundwater basin. An understanding of the safe yield of an aquifer based on water availability begins with understanding of the hydrologic budget of the Basin. A hydrologic budget is a mass balance expression which quantifies the amount of water input to and output from the Basin.

Figure 10, for example, depicts the average water supply and demand trends within the Basin. However, it is important to note that the figure was developed based on data from 1989 & 1990. As a result, current actual average inflows and outflows may vary from those in the figure. Nevertheless, the figure does illustrate the overall water budget concept. According to the figure, the total inflow into the aquifer is less than the total outflows or withdrawal from the Basin, resulting in an overdraft of between 70,000 to 85,000 acre-feet per year. For the Basin to be in balance, the outflows would have to be reduced by the amount of the overdraft; additional water would have to be imported into the Basin to compensate for the overdrafting; or a combination thereof.

It cannot be concluded, however, that the Basin inflow can be pumped from the Basin without other impacts such as localized overdraft which can create water quality degradation and increased pumping costs. It is not atypical in the San Joaquin Valley to have varying levels of water supply to different areas within a groundwater basin. This is the condition within the Turlock Groundwater Basin where the absence of surface supplies on the east side of the valley has resulted in concentrated pumping to support irrigated agriculture. Overdraft on the east side is the result. Simultaneously, surplus supplies exist in the western portion of the basin, and pumping occurs for the maintenance of groundwater levels rather than for water supply purposes. Various methods of reducing the overdraft to the Basin are discussed in "Section V" of this plan.

D. GROUNDWATER LEVELS

1. <u>Monitoring</u>

The Turlock Irrigation District monitors static and high groundwater levels on a monthly basis from a total of 248 wells within its irrigation boundaries. Forty (40) of those wells, provide information on groundwater level or "static water level" trends within the District. The District monitors the other 208 shallow monitoring wells, located at the section corners, to determine areas of high groundwater.

Like the Turlock Irrigation District, the Merced Irrigation District monitors static and high groundwater levels on a monthly basis from a total of 196 active wells within its irrigation boundaries. In addition, the Merced ID monitors shallow monitoring wells, located at the section corners, to determine areas of high groundwater. All of Merced Irrigation District's wells are located outside the area of the Turlock Groundwater Basin.

The municipalities within the Basin monitor groundwater levels on a regular basis. Most monitor water levels at each of their wells on a monthly basis, however, the cities of Modesto and Turlock have SCADA systems (Supervisory Control And Data Acquisition control systems that allow the remote operation and management of systems) and water level sensors in the wells, which allow for continuous water-level monitoring. Monitoring programs have not been established for the small public water systems regulated by the county, or for privately owned wells.

2. Historical Trends

Groundwater levels within the Basin tend to slope downward toward the west, which is the corresponding direction of groundwater flow. The groundwater levels slope secondarily northward toward the Tuolumne River and southward toward the Merced River.

These primary and secondary features of the geographic distribution of groundwater levels are shown on Figures 5 through 9, which display water levels for 1971, 1976, 1981, 1986, and 1991 respectively. The water-level contours on these figures are those produced by the California Department of Water Resources from water-level measurements in generally shallow wells throughout the Basin.

The groundwater levels for 1971, 1976, 1981, 1986, and 1991, as shown in the figures indicate that water-levels declined between 1971 and 1991. The largest water-level declines have occurred within the eastern part of the Basin, where the declines between 1971 and 1991 are as much as 90 feet. Less significant, but clearly apparent water-level declines have occurred throughout the western part of the Basin, here the general decline is about 5 ft.

These water-level declines are the result of local pumping in excess of local groundwater recharge. The observed declines in water-levels on the east side of the Basin, are largely due to groundwater pumping. Within this area, surface water supplies are not available, and pumping has produced irrigation water in a large part by depleting stored groundwater.

3. High Groundwater Levels on the West Side/Drainage Pumping

There are areas in the western portion of the Basin that experience localized high groundwater levels. The affected area varies from year to year and over the course of an irrigation season as a result of pumping, precipitation and applied irrigation water. If left uncontrolled, groundwater levels of less than six (6) feet from ground level would not be uncommon, resulting in potentially adverse impacts to local crop production.

To minimize these potentially adverse impacts on crops, the TID provides groundwater control or "drainage pumping" in areas where groundwater levels are within 6 feet of the ground surface. The District has historically controlled these high groundwater levels by using wells, specifically designed and located for drainage purposes. The TID owns, operates and maintains approximately 170 drainage wells within their service area. In recent history, subsurface drains have also been utilized to control groundwater levels. Water pumped for drainage purposes, either from a drainage well or subsurface drain, is typically discharged into the District's canal system where it is utilized, as much as possible, for irrigation purposes.

The Merced Irrigation District owns, operates and maintains 95 drainage wells all of which are located outside of the Turlock Groundwater Basin. These wells were originally installed for drainage pumping in areas where groundwater levels were within 6 feet of the ground surface. Generally, localized high groundwater levels within Merced ID have declined steadily over the last 10 years. As a result, many of the drainage wells are now used exclusively for irrigation purposes during periods when insufficient surface water is available.

4. Influence of the Rivers

As discussed in Section III.A., the Basin is bounded on three sides by the Tuolumne, San Joaquin and Merced Rivers. There are portions of all three rivers that may be gaining (carrying groundwater from the Basin) or losing (recharging water into the Basin) reaches. The actual extent of these reaches, and their impacts on the Basin are not currently known.

E. WATER QUALITY

1. Groundwater Quality Monitoring

Water quality monitoring requirements for public water systems are set by Title 22, Chapter 15, of the California Code of Regulations and vary depending upon the type of water system. Large public water systems (greater than 200 service connections) are regulated by the State of California. Wells at large public water systems must be sampled, for general mineral, physical, inorganic, organic, and radiological analyses. Small public water systems (less than 200 service connections) are regulated by local county environmental health agencies. Sampling of small public water systems is dependent upon type of water system: small community, non transient non community, transient non community or state small. Public water systems are required to perform routine bacteriological analyses, usually from water distribution systems. Frequency of bacteriological analyses is defined in Title 22, Chapter 15, California Code of Regulations, and varies depending upon type of water system.

A standardized monitoring system has not been established for the agricultural community. Individual farmers and agencies do monitor groundwater quality, however, the monitoring frequency and constituents monitored varies throughout the Basin.

2. Water Quality Conditions

There are numerous constituents found in the Basin's groundwater supply. Some constituents are naturally occurring, while others have been introduced into the groundwater from man-made sources. There are many constituents found in groundwater which do not, according to current water quality standards, have the potential to impact groundwater usage within the Basin. These constituents are not addressed in this section. The constituents identified in this section either currently impact groundwater usage within the Basin, or have the potential to impact the Basin's future groundwater usage.

a. Salinity

Salinity levels within the Basin range from excellent to unusable for household and agricultural purposes (total dissolved solids (TDS) of 90 to 5,390 ppm). For comparison, the suggested guidelines for the TDS content of irrigation water for various crops, determined by the University of California Cooperative Extension in the Turlock area, are shown on Table 6. These guidelines show the allowable TDS for salt-tolerant crops is as low as 450 ppm.

Total dissolved solids in groundwater in the eastern two-thirds of the Basin is generally less than 500 ppm. TDS in groundwater increases westward towards the San Joaquin River and southward towards the Merced River. In these areas, high TDS water is found in wells deeper than 350 feet. Better quality groundwater (less than 1,000 ppm) in these areas is found at shallower depths.

Groundwater with high TDS concentrations in the Basin is principally the result of the migration of a deep, saline water body which originates in regionally deposited, marine sedimentary rocks that underlie the San Joaquin Valley. The depth of this saline water body within the Basin boundaries, is very shallow compared to other parts of the Valley.

Groundwater with high concentrations of total dissolved solids is present beneath the entire Basin at depths from about 400 feet in the west to over 800 feet in the east. The shallowest high TDS groundwater occurs in zones five (5) to six (6) miles wide adjacent and parallel to the San Joaquin River and the lower part of the Merced River west of Hilmar, where high TDS groundwater is upwelling.

Under natural pressure, the saline groundwater body is migrating upward. Brines move up through permeable sedimentary rocks and also up through wells, faults and fractures. The chemistry of groundwater in the Basin indicates that mixing is occurring between the shallow, fresh groundwater and the brines, which produces the high TDS groundwater observed. Pumping of deep wells in the western and southern parts of the Basin may be causing these saline brines to upwell and mix with fresh water aquifers more rapidly than under natural conditions.

The Corcoran clay has provided a natural impediment to the migration of high TDS groundwater from the confined aquifer into the unconfined aquifer. High permeability pathways through the clay from the confined to the unconfined aquifer may be created by wells perforated in both the unconfined and confined aquifers.

b. Nitrates

Nitrate is an important parameter in drinking water, and in some cases may affect crops. Nitrate can be from both natural and man-made sources, and is widespread in groundwater in many parts of the San Joaquin Valley. High concentrations of nitrate in groundwater are mostly a concern for potable water supplies. The maximum contaminant level (MCL) for nitrate in public drinking water supplies is 45 mg/l (as $NO3$). Communities within the Basin, including Ceres, Turlock, Keyes, Delhi, Hilmar, Denair and South Modesto have had wells test high in nitrate concentrations close to or exceeding the current MCL. Nitrate in irrigation water is not a major concern for many crops, since it acts as fertilizer. However, permanent crop production, including grape vineyards, may be adversely affected by excess nitrate concentrations. High nitrate concentrations are typically found in shallower groundwater zones. It has been attributed to various sources, such as agricultural fertilizers, sewer effluent, septic tank disposal, and animal wastes.

c. Iron and Manganese

Groundwater in several areas within the Basin has elevated iron and manganese levels. Some wells in the cities of Ceres and Turlock, as well as within what was the Del Este system have encountered problems due to manganese. Generally "reducing conditions" (lack of oxygen) may lead to elevated iron and manganese levels in groundwater. Also, shallow groundwater near streams often has high manganese and sometimes high iron concentrations.

d. Boron

Boron in drinking water is not generally considered a health hazard to humans and is not currently a concern for public drinking water suppliers within the Basin. Boron concentrations up to 30 mg/l are not considered harmful in drinking water. However, concentrations above 30 mg/l may interfere with digestion due to boron's preservative effect on foods. It has been recommended that a boron limit of 20 mg/l be applied to drinking water ("Water Quality Criteria," published by the California State Water Resources Control Board, 1976).

Boron is found in most waters used for irrigation in the United States. Although traces of boron are essential for all plant growth, concentrations above the plant tolerance level can cause damage to the plant and reduce crop production. Plant tolerances for crops currently grown within the Basin varies from 0.5 mg/l for the most sensitive crops to approximately 10.0 mg/l for the most tolerant. Current boron concentrations in irrigation water are within plant tolerance levels and are not adversely impacting crop production.

e. Arsenic

Arsenic concentrations in water from public water supply wells in the Basin are below the current MCL of 0.05 mg/l. The Environmental Protection Agency (EPA) is currently evaluating the MCL for arsenic, if lowered this will have an impact on groundwater usage within the Basin.

f. Radionuclides

The MCL for gross alpha is 15 picocuries per liter, and the MCL for uranium has recently been increased from 5 to 20 picocuries per liter. These parameters are primarily from natural sources and affect drinking water supplies. Sampling in the Basin for radiological constituents has generally been limited to public water systems.

Groundwater with high uranium activities has been detected in the past 10 years in the Hilmar and Hughson areas. The occurrences are indicated to be natural and are based on available data.

The EPA has discussed establishing a standard for radon in drinking water. Depending on how low this standard is set, natural activities of radon could be a concern in the future.

g. Bacteria

Bacteriological quality in the Basin is generally acceptable in deep groundwater aquifers. Bacteriological quality of groundwater pumped by individual wells can not be generalized and depends on many factors pertaining to the well and surrounding conditions.

Inadequately constructed and improperly located, destroyed or abandoned water wells may contribute to bacteriological contamination of groundwater. Some of the factors that may influence contamination of water wells include: location with respect to sources of contamination; inadequate construction features being present on wells; general deterioration and or inadequate maintenance of wells; improper use of water wells for disposal of wastes.

Bacteriological contamination of groundwater is a health concern since groundwater is used for drinking water. Water wells used to supply drinking water should be routinely tested for pathogenic microorganisms.

h. Pesticides

Pesticide contamination is primarily the result of the widespread use of the agricultural nematicide Dibromochloropropane (DBCP) on crop lands for several decades before it was banned in 1977. DBCP in the groundwater is usually associated with vineyards or orchards where the pesticide was used. DBCP is a carcinogen at very low concentrations in water, and is a concern for potable water supplies. It moves freely with the groundwater and persists for long periods. The MCL for DBCP is 0.2 micrograms per Liter (μg/l). DBCP has been found in public water supply wells in the So. Modesto, Keyes and Ceres areas at levels either close to or exceeding the MCL. In the case where the DBCP levels are exceeding the MCL, wellhead treatment is being utilized.

Another pesticide that has been detected in the Basin's groundwater is ethylene dibromide (EDB). EDB (another agricultural nematicide, used primarily on vineyards, that was banned in the early 1980's) has been detected in one public water supply well in the Turlock area.

i. Trichloroethylene

Trichloroethylene (TCE) is a nonflammable, colorless liquid with a sweet odor and is used as a solvent for dyes, rug cleaners, as well as a degreaser for metal parts.

Improper storage and disposal have made TCE a major contaminant of groundwater supplies in California, however the extent of TCE contamination within the Basin is currently unknown. TCE is known to contaminate water wells close to refineries, metal processing plants, chemical manufacturers, military bases, and electroplating operations. The contamination is persistent due to TCE's long half-life in groundwater which typically ranges from 9 months to 3 years.

The California Drinking Water Action Level of 5 ppb (5 parts per billion is equivalent to 5 μg/l) for TCE is based upon what is considered a negligible risk level for cancer. In other words, if one million people drank about 2 liters of water containing TCE at this level every day over a 70 year lifetime, there would theoretically be no more than one additional case of cancer in the million people exposed.

j. Other Trace Organics

Other trace organic compounds have been detected in the Basin's groundwater including, but are not limited to, carbon tetrachloride, perchloroethylene and hydrocarbon-based products. Improper use, storage and accidents have resulted in unauthorized releases of these substances.

Volatile organic compounds (VOC's) derived primarily from solvents have contaminated the groundwater, in some areas. Some of these can be attributed to industries that handle, store and use solvents. Perchloroethylene (PCE) has been detected at one time or another in some of the Basin's public water supply wells. Industrial wastes and dry cleaners are a recognized source of PCE in groundwater in some municipal areas, such as the City of Turlock.

Carbon tetrachloride is often attributed to auto repair shops which have historically used it as a solvent or degreaser. There are no records of carbon tetrachloride being found in concentrations above the MCL of 0.5 μg/l in public water supply wells within the Basin.

Several unauthorized releases from underground storage tanks (UST) have occurred in the Basin. Most of these cases are very localized in nature in terms of groundwater impacts, and public water supply wells are not known to have been affected. The Merced County Division of Environmental Health, and the Stanislaus County Department of Environmental Resources is involved in monitoring and regulating the clean-up of sites involving many VOC and UST spills. The county agencies have a contract with the State Water Resources Control Board to provide mitigation services for the definition and clean-up of releases resulting from underground storage tanks.

F. AREAS OF CONCERN

Agricultural and municipal agencies within the Basin are concerned about maintaining adequate supplies of groundwater within the Basin. Groundwater is the primary source of water for the agricultural agencies on the eastern side of the Basin. As a result, they are concerned about the continued decline of groundwater levels on that side of the Basin. The municipalities, which also rely on groundwater for their source of water, are not as concerned about the present quantities of water as they are about the future quantities of water which will be needed as the cities continue to expand.

Agencies within the Basin are also concerned about maintaining the Basin's groundwater quality. The Basin, generally, has good quality groundwater. As a result, the municipalities are not currently required to provide significant water treatment. However, there are some areas of water quality concern. For example, saline brines continue to migrate upward from the saline confined aquifer, resulting in increased salinity levels. In addition, constituents such as PCE, DBCP, EDB, uranium, nitrates, manganese and iron have been found in a few water supply wells within the Basin. In a few cases, these constituents have impacted the municipalities' ability to utilize the wells to supply potable water and resulting in the wells being retired, or requiring some form of treatment. In the future, the municipalities within the Basin may be required to investigate various options, such as well head treatment, to meet ever increasingly stringent minimum water quality requirements.

V. ELEMENTS OF A GROUNDWATER MANAGEMENT PLAN

A. PLAN COMPONENTS

It is recognized that groundwater management needs are expected to change, as Basin conditions change. The plan is designed to adjust according to the needs of the Basin. Therefore, the elements of the Groundwater Management Plan for the Basin include, but are not limited to, the following components.

1. Control of Saline Water Intrusion

Permanent degradation of good quality groundwater can occur if poor quality groundwater migrates into aquifer zones containing better quality water. Such degradation can seriously affect the usability of the groundwater especially for potable uses. Variations in soil conditions, soil type, geologic structure, irrigation practices, and irrigation water quality can result in a wide variation in the quality of groundwater, especially in the upper water bearing zones. Because of these influences, groundwater salinity is the lowest in the easterly portion of the Turlock Groundwater Basin and increases westward towards the San Joaquin River and southward towards the Merced River. Increased groundwater pumping can alter historical flow patterns and cause the poor quality groundwater to commingle with and contaminate the better quality groundwater.

Also, as has been described, there is the natural tendency of deep saline water to up-well; i.e., move vertically upward and mix with the better quality water above it. Increasing the pumping of the fresh water increases the hydraulic gradient between the two zones, which increases the rate of fresh water degradation.

To maximize the sustainability of the groundwater basin, knowledge of the various water quality zones and the groundwater flow patterns is necessary. With this information, groundwater management techniques can be evaluated to protect zones of high quality water so that the beneficial use of the groundwater supply can continue. A program to minimize water quality degradation due to saline water intrusion should include the following elements:

a. Establish a network of monitoring wells completed to various depths throughout the management area.

b. Monitor well water quality annually for salinity, nitrates, boron, and other constituents that may be of concern, i.e., certain organic chemicals such as dibromochloropropane (DBCP). Monitoring requirements may change with evidence of salinity change.

c. Identify areas where the groundwater flow patterns suggest a high probability of water quality degradation.

d. Identify zones of marginal quality water that can be used in conjunction with surface water to increase the water supply for agricultural purposes and reduce migration of saline water into zones containing potable groundwater.

e. Identify water management strategies that may be employed to minimize degradation.

If water quality changes begin to occur, the cause should be investigated and action taken to reverse the trend.

2. <u>Identification and Management of Wellhead Protection and Recharge Areas</u>

The Federal Wellhead Protection Program (WPP) established by Section 1428 of the Safe Drinking Water Act Amendments of 1986 is designed to protect groundwater resources of public drinking water from contamination to minimize the need for costly treatment to meet drinking water standards. A wellhead protection area (WPA), as defined by the 1986 Amendments, is "*the surface and subsurface area surrounding a water well or well field supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water or well field.*" Under the act, the states are required to develop an EPA approved WPP. To date, California does not have a formal program but instead relies on public agencies to plan and implement programs under AB 3030. The basic task of wellhead and recharge area protection programs is the identification of zones around public water supply wells and groundwater recharge areas where land use must be controlled to minimize the possibility of contamination of the drinking water supply. Merced County has developed and adopted a comprehensive county-wide wellhead protection program (see Appendix H).

Recharge in the Turlock Groundwater Basin occurs primarily from percolation of excess irrigation water, seepage losses from canals and ditches and, to a lesser extent, from rainfall. Protection of recharge areas is realized by controlling or regulating surface contaminants before their migration into the groundwater, either by percolation or, more directly, via wells that have not been properly constructed or destroyed.

Regulation of waste disposal is administered by the Regional Water Quality Control

Board (RWQCB), the Department of Toxic Substances Control (DTSC), or the local county environmental health agencies. Each participating agency should provide assistance to the RWQCB, DTSC, and the local county environmental health agencies by identifying areas that are the most susceptible to groundwater contamination.

To protect recharge areas, each participating agency should review applications for Waste Discharge Permits within and adjoining their boundaries that have the potential to degrade groundwater quality. Such waste disposal systems include disposal of dairy wastes, disposal of industrial wastes, sewage treatment plant effluent disposal, and solid waste disposal. Environmental documents for such facilities and Tentative Waste Discharge Permits issued by the RWQCB should be closely reviewed such that appropriate monitoring and mitigation measures are developed to preclude the possibility of migration of pollutants from the disposal sites. Each participating agency should be on the lookout for existing and proposed land use activities that have the potential to degrade groundwater quality, so that appropriate action can be taken.

A wellhead protection program for public water supply wells should be developed, around the following basic plan elements:

a. Identification and description of all public water supply wells in the Turlock Groundwater Basin.

b. Delineation of the WPA for each well based on groundwater flow and quality information developed under Elements #1 (Control of Saline Water Intrusion) and 7 (Monitoring and Controlling Groundwater Levels, Quality and Storage).

c. Identification of potential sources of contaminants within each WPA.

d. Establishment of land use ordinances to preclude or control future land uses within each WPA that have the potential for groundwater contamination.

e. Development of site specific well construction and abandonment programs to minimize contaminant migration [Elements #4 (Administration of Well Abandonment and Well Destruction Program) and 9 (Well Construction)].

f. Development of a contingency plan to implement if a WPA becomes contaminated.

3. <u>Regulating Contaminant Migration in Groundwater</u>

Contaminants in this section are those that result from improper application, storage or disposal of petroleum products, solvents, pesticides, fertilizers, sewage effluent, and chemicals used by industry, and are distinguished from the salinity degradation that is addressed in Element #1 (Control of Saline Water Intrusion). Each participating agency's role in protecting groundwater from contamination by point sources should include supporting the RWQCB, which holds the primary responsibility for enforcing water quality regulations, and the respective counties who oversee soil and groundwater cleanup activities from leaking underground storage tanks and other point source contamination sites. Each participating agency should assist in understanding the hydrogeology of the Turlock Groundwater Basin, the vertical and lateral groundwater flow directions, and groundwater quality based on the groundwater monitoring activities carried out by each participating agency. In addition, each participating agency should make the appropriate regulating agency aware of changes in groundwater quality, which may indicate that point source contamination is occurring.

4. Administration of Well Abandonment and Well Destruction Program

State regulations require that all unused or inactive wells be properly maintained, as defined by the "Water Well Standards: State of California," DWR Bulletins 74-81 and 74-90. State regulations also requires all inactive wells that are not properly maintained (in accordance with Section 24400 of the California Health and Safety Code) be properly destroyed. Wells that are not properly maintained or destroyed can act as conduits for mixing of groundwater of differing quality or create a safety problem. Non-pumped wells are a much greater threat than pumped wells, since pumping normally quickly removes contaminants that may have migrated during idle periods.

Permits are required from the applicable county and/or city for destruction of wells within their respective jurisdictions. For public water supply wells, additional requirements may be prescribed by the State Department of Health Services (DOHS). Each participating agency will rely on continued administration of the well abandonment and destruction program by the permitting agencies. Each participating agency's role in well abandonment and destruction should be to provide available groundwater data, assist in identifying locations of operating and abandoned wells, and advise well owners why proper well destruction is important for protection of water quality.

5. Mitigation of Groundwater Overdraft

The significant area of overdraft is in the eastern portion of the Basin, where irrigation water is supplied primarily by groundwater pumping. For many years, the amount of pumping has exceeded the local recharge, creating a condition of local groundwater overdraft. The average annual overdraft is estimated to be 70,000 - 85,000 acre-feet per year. Unless the amount of recharge is increased or the amount of pumping is reduced, eventually groundwater levels may decline to such depths that farming the overlying lands, which rely primarily on groundwater, could no longer be economical. In addition, the wells surrounding the area of overdraft may be adversely affected by the lowering of the water table and/or by water quality changes that can occur due to changes in hydraulic gradients. The depletion also reduces the amount of groundwater available within the Basin for use when surface water supplies are low. To avoid these impacts, it is necessary that methods to recharge the overdraft area be identified, evaluated, and implemented, if economically and environmentally feasible. Restrictions on pumping is the other available method of mitigating groundwater overdraft, but should not be considered until all possible and reasonable means of recharge have been shown not to be viable.

One of the most cost effective ways to manage the Basin to achieve aquifer recharge is through a conjunctive use program. Conjunctive use of surface water and groundwater is discussed in more detail under Element #8 (Facilitating Conjunctive Use Operations).

6. Replenishment of Groundwater Extracted by Producers

Most of the recharge of the Turlock Groundwater Basin occurs from irrigation water diverted from the Tuolumne River. As the water is transported and distributed to the field, a certain amount of seepage loss occurs, which percolates through the soil and recharges the groundwater basin. As irrigation water is applied to crops, a portion of the applied water percolates past the root zone and continues downward, also recharging the groundwater basin. To increase replenishment, additional surface water must be absorbed within the Basin either by increasing surface water irrigation to displace groundwater use, or by direct recharge. Through implementation of Element #8 (Facilitating Conjunctive Use Operations), each participating agency should be exploring methods of replenishing the depleted groundwater supplies and optimizing use of available aquifer storage.

7. Monitoring and Controlling Groundwater Levels, Quality and Storage

The purposes of a groundwater level and quality monitoring program are to identify areas of overdraft and provide information that will allow computation of the changes in groundwater quality and storage. Groundwater level monitoring is essential to understand the impacts on the aquifer resulting from changes in surface water supply conditions and in groundwater pumping activities. Such monitoring is also a necessity in administering any conjunctive use program. Groundwater quality monitoring is essential to detect any adverse impacts on the groundwater supply and indicate any necessary changes to protect the Basin's groundwater quality.

Several local agencies throughout the Basin have established groundwater monitoring programs. The Turlock Irrigation District, for example, currently obtains monthly water level measurements from 248 wells [40 deep wells (a combination of drainage and rented irrigation wells) and 208 shallow monitoring wells] throughout their district. In addition, the cities are required to routinely test the groundwater quality of their water supply wells. These existing monitoring programs should be coordinated and expanded to develop a comprehensive basin-wide groundwater monitoring program.

Monitoring well networks should be established to monitor water levels both above and below the Corcoran Clay. Water levels in the confined aquifer below the Corcoran Clay can then be compared to water levels in the unconfined level above the Corcoran Clay to determine the hydraulic gradient between the two zones. The hydraulic gradient is an important component in the understanding of how pumping affects the movement of water from one aquifer zone to the other, and the potential for such movement to impact groundwater quality. An adequate monitoring well network should include representative wells that tap the two major aquifer zones in the Basin. Basic elements should include:

a. Expand the current network of monitoring wells to cover the entire Basin.

b. Compile the necessary data on the monitoring wells, e.g., location, depth, Driller's Log, E-log, casing elevation and ground surface elevation.

c. Establish the frequency of water level and quality monitoring.

d. Inventory active wells and determine annual pumping amounts.

e. Develop a standardized data collection method.

f. Tabulate data and prepare groundwater mapping.

g. Interpret and disseminate results.

8. Facilitating Conjunctive Use Operations

Conjunctive use of groundwater and surface water in a groundwater basin typically occurs when the surface water supply to the Basin varies from year to year and Basin water demand is relatively constant. In some years, the surface water supply is greater than the Basin water demand; in other years, the surface water supply is less than the Basin water demand. In the years of plentiful supply, surface water is utilized to recharge the groundwater aquifer. Recharge can occur either directly by surface recharge or injection well, or by using surface water in lieu of groundwater when it is available. In effect, the groundwater basin is utilized as a storage reservoir and water is placed in the reservoir during wet years and withdrawn from the reservoir during dry years.

In the Turlock Irrigation District and Merced Irrigation District portions of the Basin, groundwater and surface water have historically been utilized conjunctively on an informal basis. That is, there has been no formalized plan for the conjunctive use operation and water placed into the groundwater basin and extracted from the Basin has not been inventoried. Because of the availability and variability of the surface water supply, there may be opportunity for better utilization of the Basin's overall water supply through an expanded program. A conjunctive use program offers the best opportunity to provide relief to the local overdraft condition that exists in the eastern portion of the Basin.

A traditional conjunctive use program would consist of constructing a surface water distribution facility in the east side agricultural area currently served primarily with groundwater (primarily the Eastside and Ballico-Cortez Water Districts), or installation of injection wells and/or recharge basins on the east side. The recharge, which would occur utilizing the distribution system is referred to as "in-lieu" recharge, since surface water would be used in lieu of groundwater. The decrease in groundwater extraction would allow groundwater levels to recover. The injection wells and/or recharge basins could be used for direct recharge of groundwater.

Both the Eastside Water District and the Ballico-Cortez Water District have been working with the Turlock Irrigation District investigating the possibility of expanding the conjunctive use of groundwater and surface water to increase the utilization of surface water when available. With the implementation of the groundwater management plan, these activities are expected to continue and may be expanded to include others in the groundwater basin.

9. Well Construction

Improperly constructed wells can establish pathways for pollutants to enter from surface drainage and can cause mixing of water between aquifers of differing quality. Sections 13700 through 13806 of the California Water Code require proper construction of wells. The standards of well construction are specified in DWR Bulletins 74-81 and 74-90.

The counties and cities within the Turlock Groundwater Basin have the responsibility to enforce well construction standards. Well construction permits are required to drill a new well or to modify an existing well. Well Driller's Reports must be filed with the DWR and the respective counties. Stanislaus County has adopted the DWR standards. Merced County, however, has adopted their own standards which are stricter than the established DWR standards.

Because of their responsibility to enforce standards for construction and destruction of wells and for issuance of drinking water permits for small public water systems, the county environmental health agencies maintain records on wells and groundwater quality. The records maintained by the various counties should be supplemented with data on water levels and groundwater quality collected by each participating agency to identify locations susceptible to intermixing of aquifer zones of varying water quality. The information would be used to establish specifications for well construction and destruction to optimize well water quality and minimize mixing of water between zones of varying water quality. Better understanding of the subsurface geology and water quality is needed to define the confining beds between aquifer zones of differing water quality. Site specific hydrogeologic investigations may be necessary to support well designs and should be submitted with the proposed well designs to obtain the well drilling permit.

Authority over well construction will remain with the respective counties and cities. A method needs to be developed to exchange pertinent well information to assist in groundwater management activities.

10. Construction and Operation of Recharge, Storage, Conservation, Water Recycling and Extraction Projects

As part of the groundwater management plan, projects to improve water utilization within the Turlock Groundwater Basin should be identified and evaluated. Potential projects include:

a. Use of reclaimed wastewater for agricultural or landscape irrigation purposes.

b. Expanded surface water distribution systems to increase its use.

c. Construction of recharge facilities in the eastern portion of the Basin.

d. Construction of additional surface water storage facilities to increase water availability.

For items b and c, sufficient additional surface water or conserved water must become available to make these projects viable. Construction of additional surface water storage facilities or redistribution of current supplies under an expanded conjunctive use program may be needed to increase water supply. Increased usage of reclaimed water could potentially reduce additional surface water requirements.

Along with the potential benefits that these projects can provide, there are associated costs. Any project must undergo a thorough evaluation to quantify the water supply benefits and to identify all costs associated with the project. In addition, many legal, contractual, and political issues are sure to arise when evaluating such projects.

11. Development of Relationships with Local, State and Federal Agencies

Each participating agency recognizes the benefit of close coordination between their efforts and the work performed by various local, state and federal agencies to monitor and protect groundwater in the Turlock Groundwater Basin. The DWR monitors groundwater levels in the San Joaquin Valley on a semi-annual basis, they also perform special studies from time to time on San Joaquin Valley water supply conditions.

The Regional Water Quality Control Board (RWQCB), under the State Water Resources Control Board, has a responsibility to protect waters of the state by reviewing projects and issuing waste discharge permits, as necessary, for disposal activities that threaten both the surface and groundwater supplies. They are also the agency with the responsibility to oversee clean-up of contaminated water.

Both the Merced County Division of Environmental Health and the Stanislaus County Department of Environmental Resources monitor the installation and abandonment of wells so as to protect the groundwater from degradation due to improper well installation and destruction, and oversee the clean-up of contamination from leaking underground tanks. The Merced County Wellhead Protection Program identifies all the additional water quality protection programs enforced by the Merced County Division of Environmental Health (see Appendix H).

Federal regulations for protection of groundwater are developed through the Environmental Protection Agency (EPA), which looks to the state for implementation. The U.S. Geological Survey (USGS) provides technical studies and reports, and maintains a data base of surface and groundwater quality.

Each participating agency should closely coordinate their management activities with the appropriate agencies, so that there will be mutual assistance amongst agencies, a minimum of duplicated work, and the establishment of efficient data compilation and exchange procedures.

12. Review of Land Use Plans and Coordination with Land Use Planning Agencies

Each participating agency should review the proposed development plans and associated environmental documentation to assess the potential groundwater impacts of proposed land use changes. Each participating agency should review initial studies, proposed negative declarations, draft environmental impact reports, and provide comments as appropriate to insure that potential threats to groundwater can be addressed and avoided. In cases where the proposed land use involves disposal of wastes, storage of hazardous materials, or handling of petroleum products, solvents, or chemicals such as pesticides and fertilizers, each participating agency should coordinate with the appropriate State regulatory agencies to insure that compliance with regulations for containment and disposal of wastes is obtained.

During periodic land use plan preparation and updates, the cities and counties in the Turlock Groundwater Basin should consult with the appropriate participating agency to avail themselves of the latest information on groundwater conditions that may be affected by proposed activities, so that necessary mitigation measures can be included in the plans.

VI. IMPLEMENTATION OF THE PLAN

The local agencies who have cooperated in the development of this groundwater management plan (GMP), include cities, counties, rural communities served by community services districts or county water districts, and irrigation or water districts that provide water primarily for agricultural use. As described in the GMP, all of the agencies rely on groundwater to some degree for their water supply. The Turlock Irrigation District, the Merced Irrigation District, and the City of Modesto are the only agencies that currently utilize surface water conjunctively with groundwater. The area of the Basin that relies solely on groundwater is in a chronic condition of overdraft. Addressing the overdraft is of high priority to those agencies that are most affected by the overdraft.

Public health considerations require that water quality standards for domestic water supply be more stringent than water quality considerations for agricultural use. Since groundwater exists within the Basin that meets the current domestic water quality standards, communities have been able to utilize untreated groundwater as a source of their domestic supply. Since untreated groundwater is the most economical water supply source, maintenance of groundwater quality is a high priority to the cities and communities.

The above examples are set forth to demonstrate that the priorities in groundwater management will vary from agency to agency, depending upon the local groundwater resource conditions and the use of the groundwater supply. Accordingly, in GMP implementation, agencies will have differing priorities regarding which elements to pursue and differing appropriate investment levels for those pursued. This situation may complicate implementation and mandates a flexible implementation strategy to accommodate the varying priorities. However, since regional water resources planning provides more opportunity for optimizing use of groundwater resources, the expected complications of GMP implementation should be far outweighed by the benefits to be achieved.

Pursuant to Water Code Section 10753.5, each participating agency must hold a second public hearing to review and take comments on the proposed GMP, and to consider protests to the adoption of the GMP. At the same time, each agency must take the appropriate action under the California Environmental Quality Act (CEQA), since the GMP may be deemed a project, as defined under CEQA. If an agency does not receive a protest for adoption of the GMP by a majority of the landowners, the agency must adopt the GMP within 35 days after conclusion of the second public hearing.

Water Code Section 10753.8 specifies that the local agency shall adopt rules and regulations to implement and enforce a GMP. In adopting the rules and regulations pursuant to this section, a local agency must consider the potential impact of the rules and regulations on business activities, including agricultural operations, and minimize impacts to such business activities.

In consideration of the regional nature of the GMP, the varying water resource management priorities among the local agencies and the requirements for developing rules and regulations for GMP implementation, the following strategy has been set forth to move the GMP from preparation and adoption by each local agency to regionally coordinated implementation:

1. After adoption of the GMP by each participating agency, an implementation coordinating committee shall be established and shall consist of one member and one alternate member from each participating agency.

2. The committee shall meet at least quarterly to assist in the coordination of groundwater management within the Basin and to guide implementation of the GMP.

3. The committee will develop rules and regulations for GMP implementation, pursuant to Water Code Section 10753.8, to be recommended for adoption by each participating agency.

4. With consideration given to identified problem areas set forth in the GMP, the committee shall establish a priority list for management actions.

5. Management activity groups will be formed of those local agencies interested in implementing certain elements of the GMP to specify management actions for the element, develop budgets, apportion costs, and conduct the appropriate environmental review of proposed projects. Binding activity agreements will be prepared specifying duties and obligations of each agency participating in the activity.

6. Each management activity group will prepare an annual summary describing the activities that have taken place, which will collectively provide an annual update of the activities under the GMP.

This implementation strategy is expected to be refined as necessary by the committee.

Appendix A

Figures

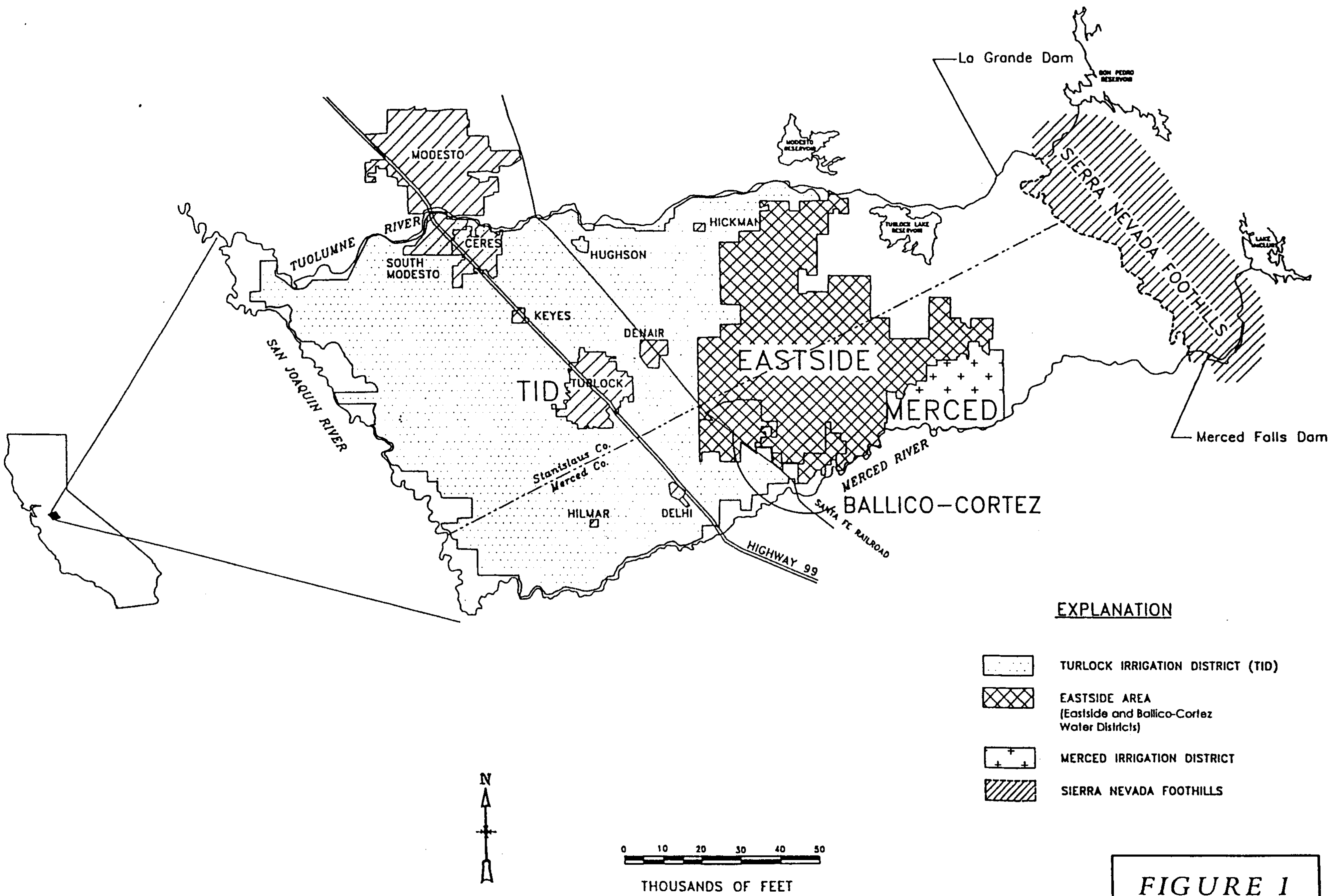
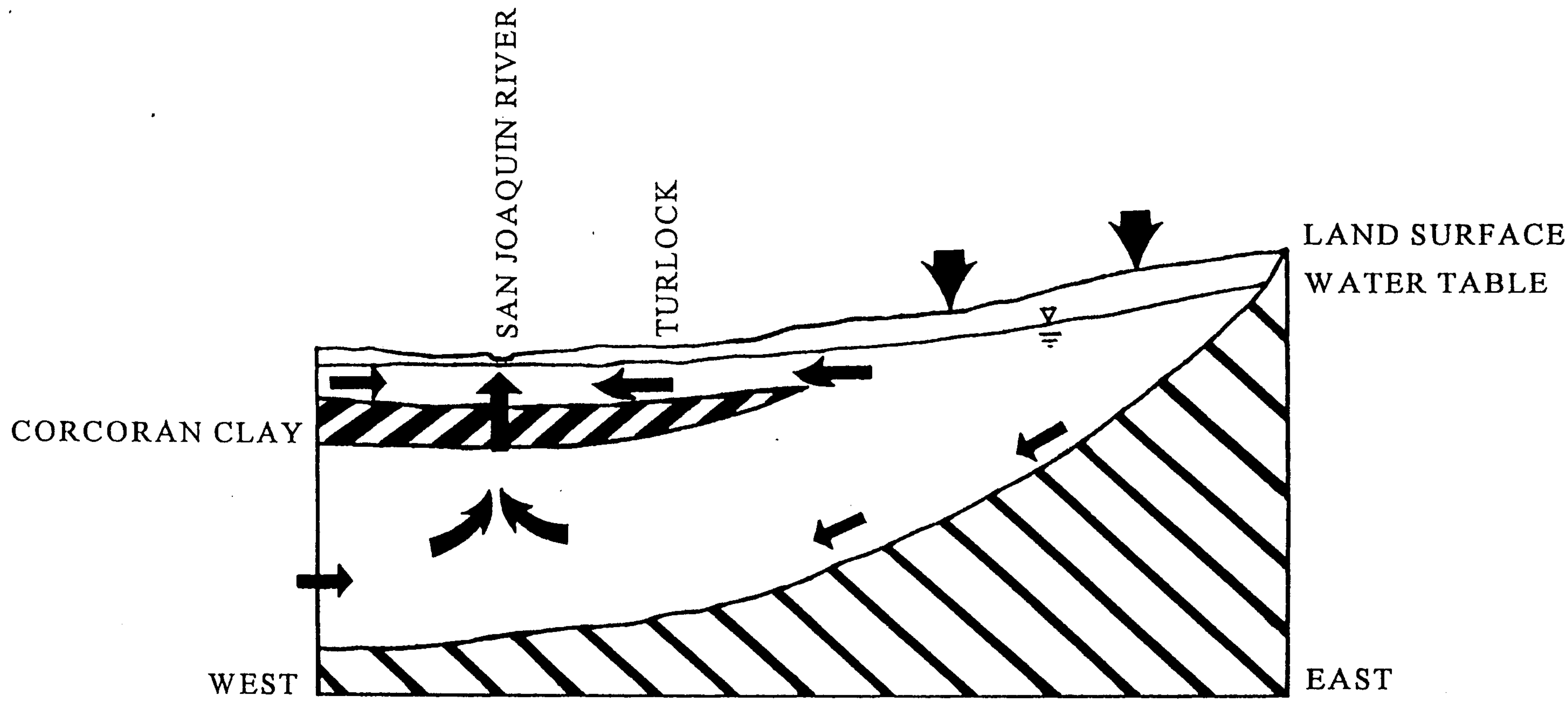

La Grande Dam
Merced Falls Dam
SIERRA NEVADA FOOTHILLS
MODESTO
CERES
SOUTH MODESTO
TUOLUMNE RIVER
SAN JOAQUIN RIVER
HICKMAN
HUGHSON
KEYES
DENAIR
TID
TURLOCK
EASTSIDE
MERCED
BALLICO-CORTEZ
MERCED RIVER
SANTA FE RAILROAD
HIGHWAY 99
Stanislaus Co.
Merced Co.
HILMAR
DELHI
EXPLANATION
TURLOCK IRRIGATION DISTRICT (TID)
EASTSIDE AREA
(Eastside and Ballico-Cortez Water Districts)
MERCED IRRIGATION DISTRICT
SIERRA NEVADA FOOTHILLS
N
0
10
20
30
40
50
THOUSANDS OF FEET

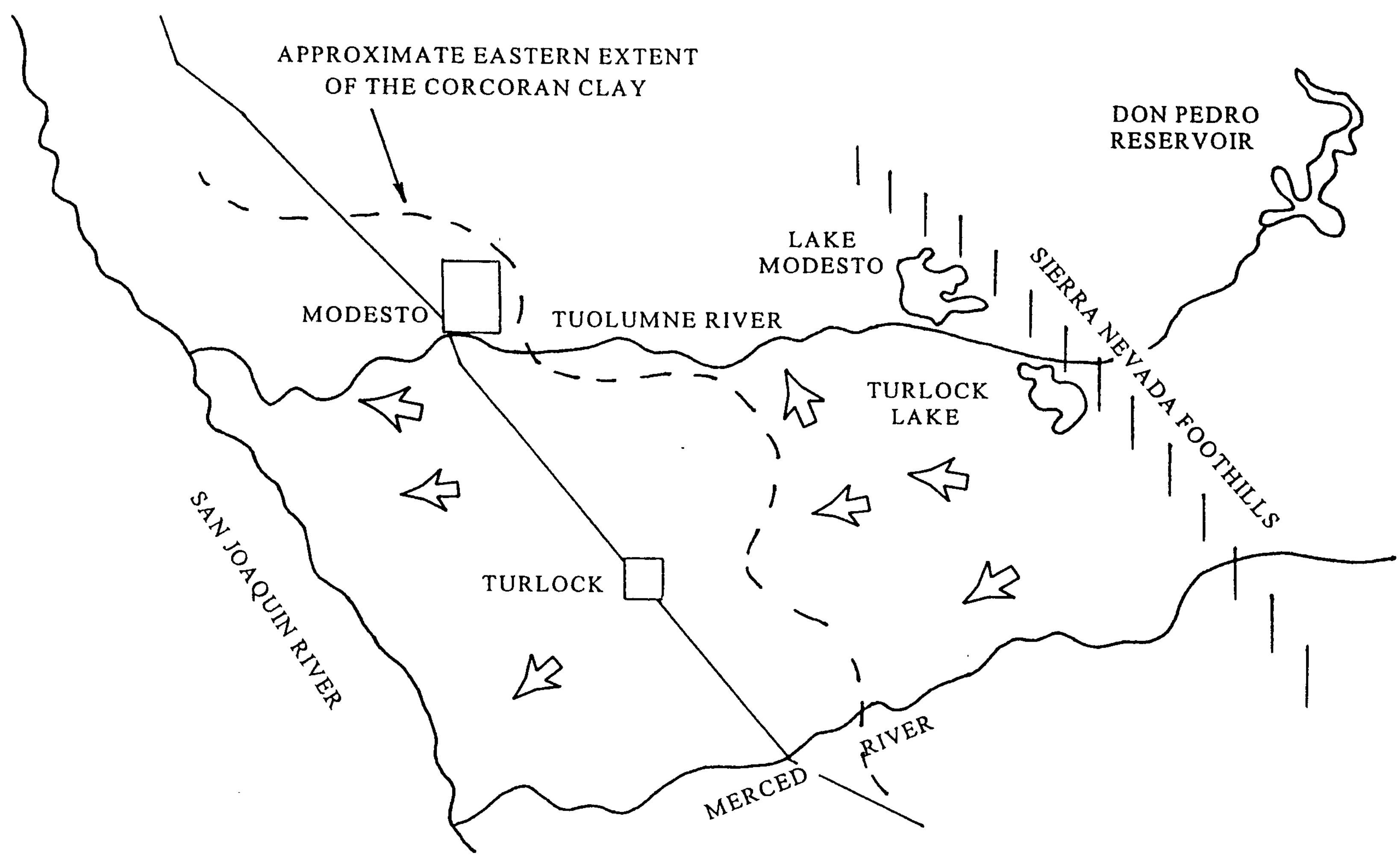
FIGURE 1



NOTE: Arrows indicate the general direction of water movement.

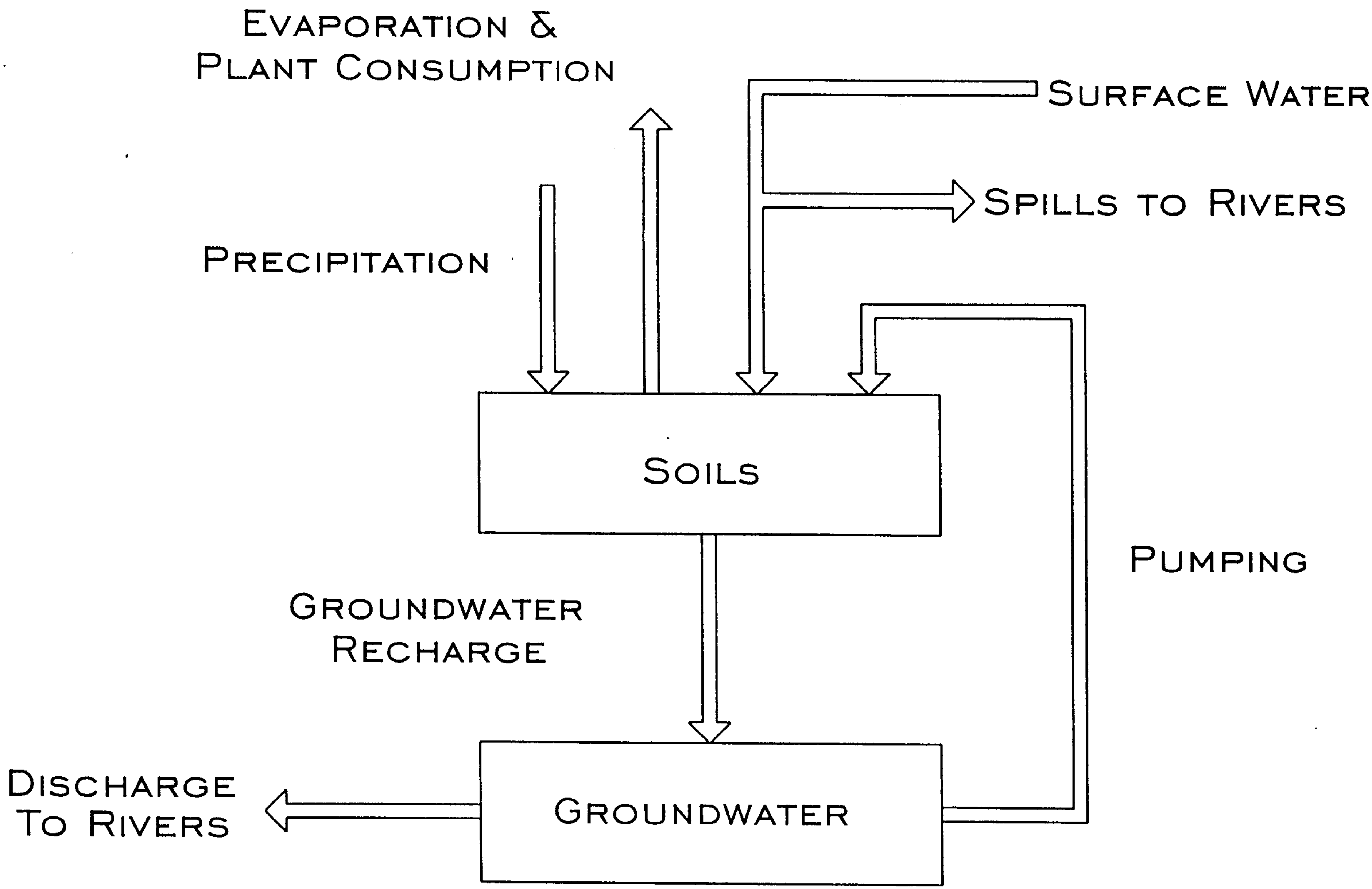
SECTION THROUGH GROUNDWATER BASIN

FIGURE 2



GROUNDWATER MOVEMENT WITHIN THE BASIN

FIGURE 3



HYDROLOGIC SYSTEM

FIGURE 4

GROUNDWATER ELEVATIONS - FALL 1971

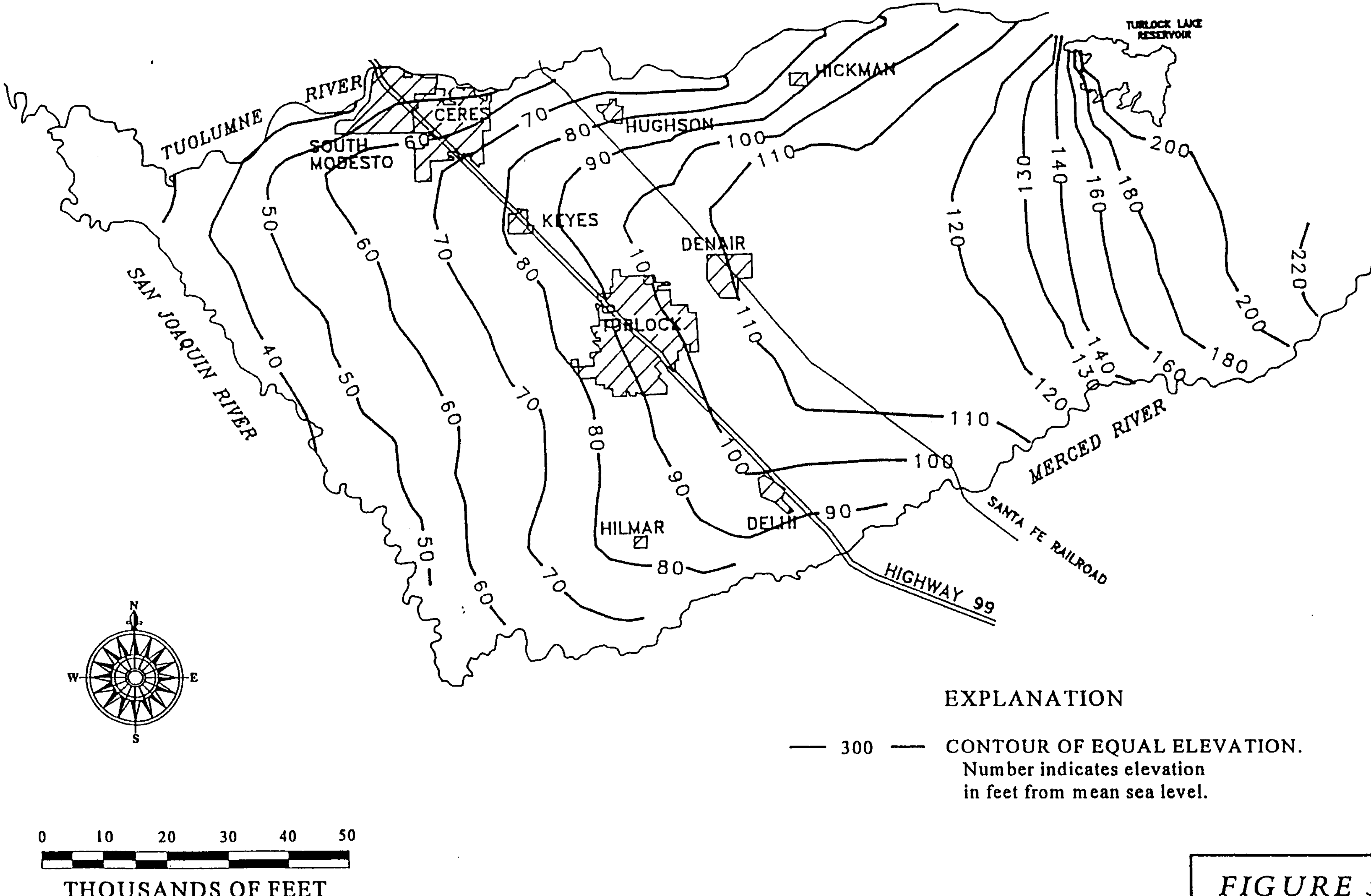
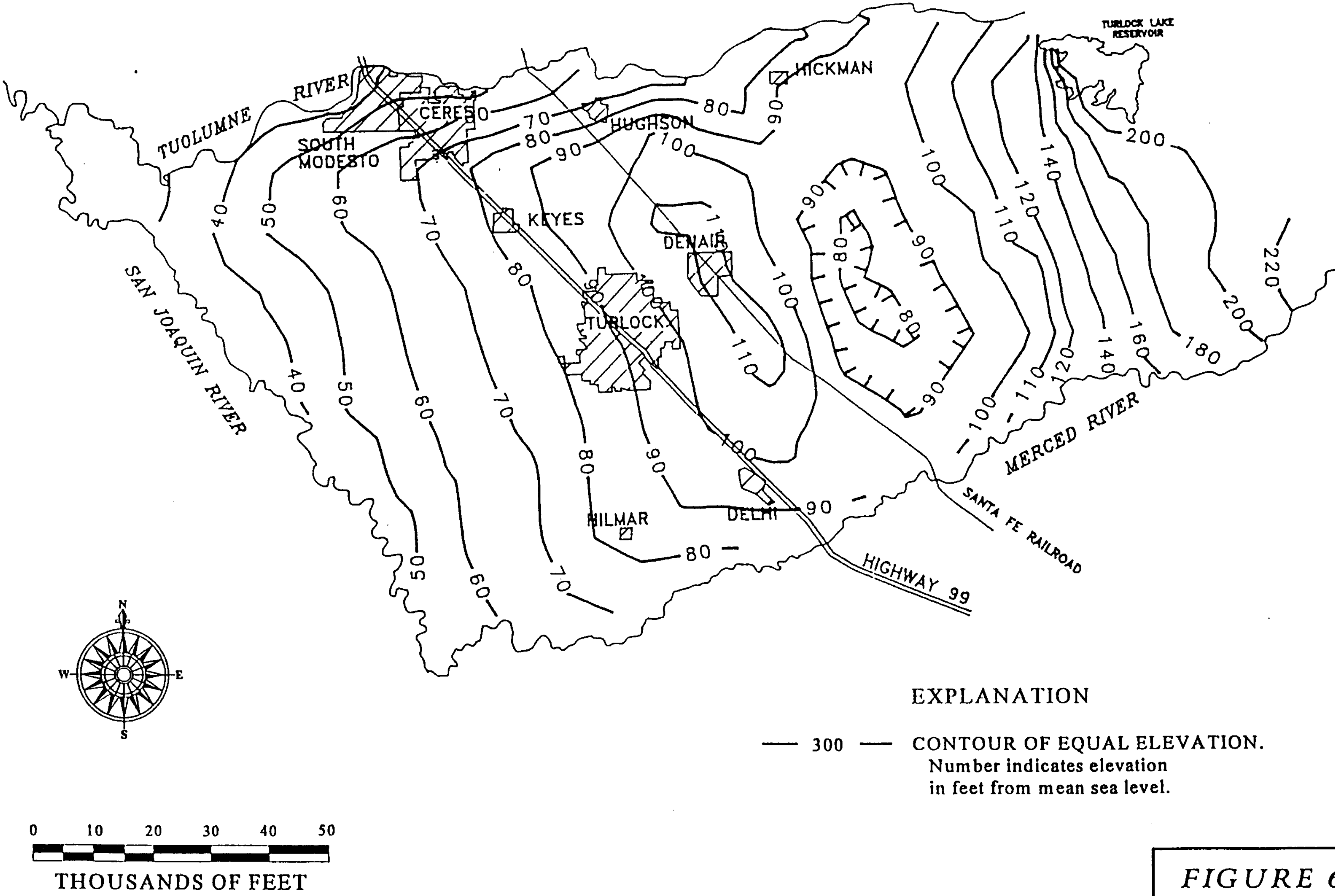


FIGURE 5

GROUNDWATER ELEVATIONS - FALL 1976

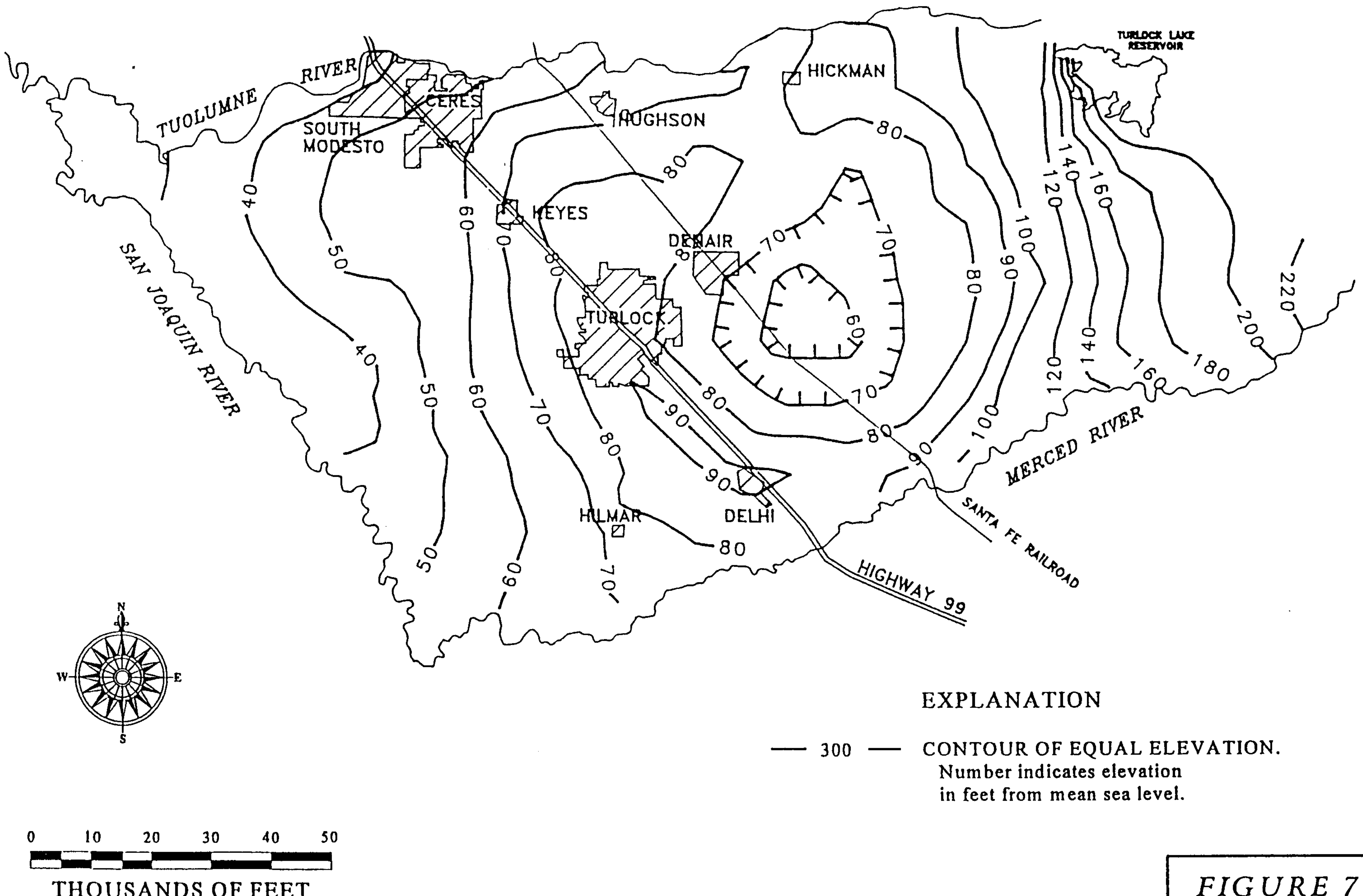


EXPLANATION

— 300 — CONTOUR OF EQUAL ELEVATION. Number indicates elevation in feet from mean sea level.

FIGURE 6

GROUNDWATER ELEVATIONS - FALL 1981

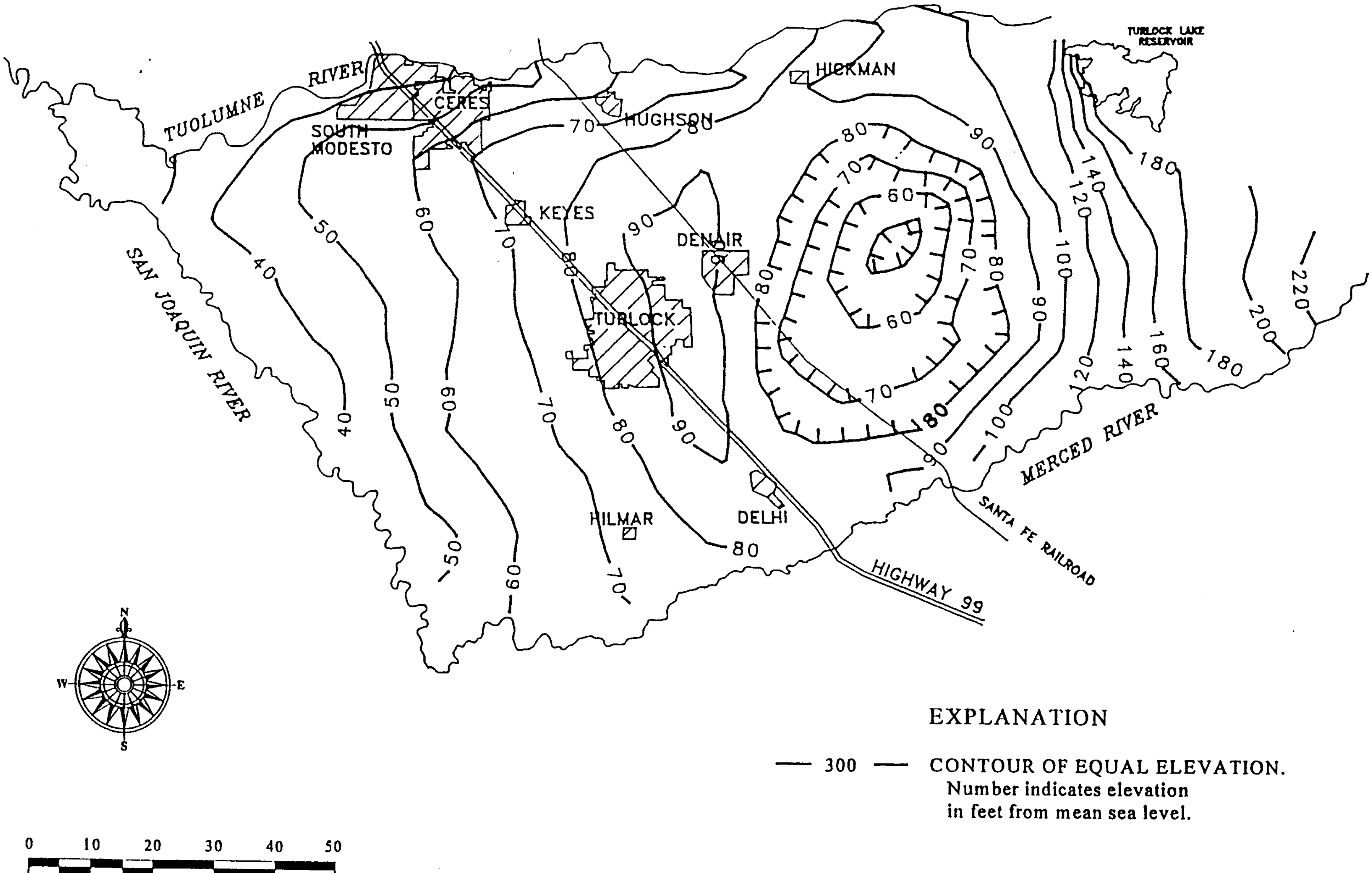


EXPLANATION

— 300 — CONTOUR OF EQUAL ELEVATION. Number indicates elevation in feet from mean sea level.

FIGURE 7

GROUNDWATER ELEVATIONS - FALL 1986

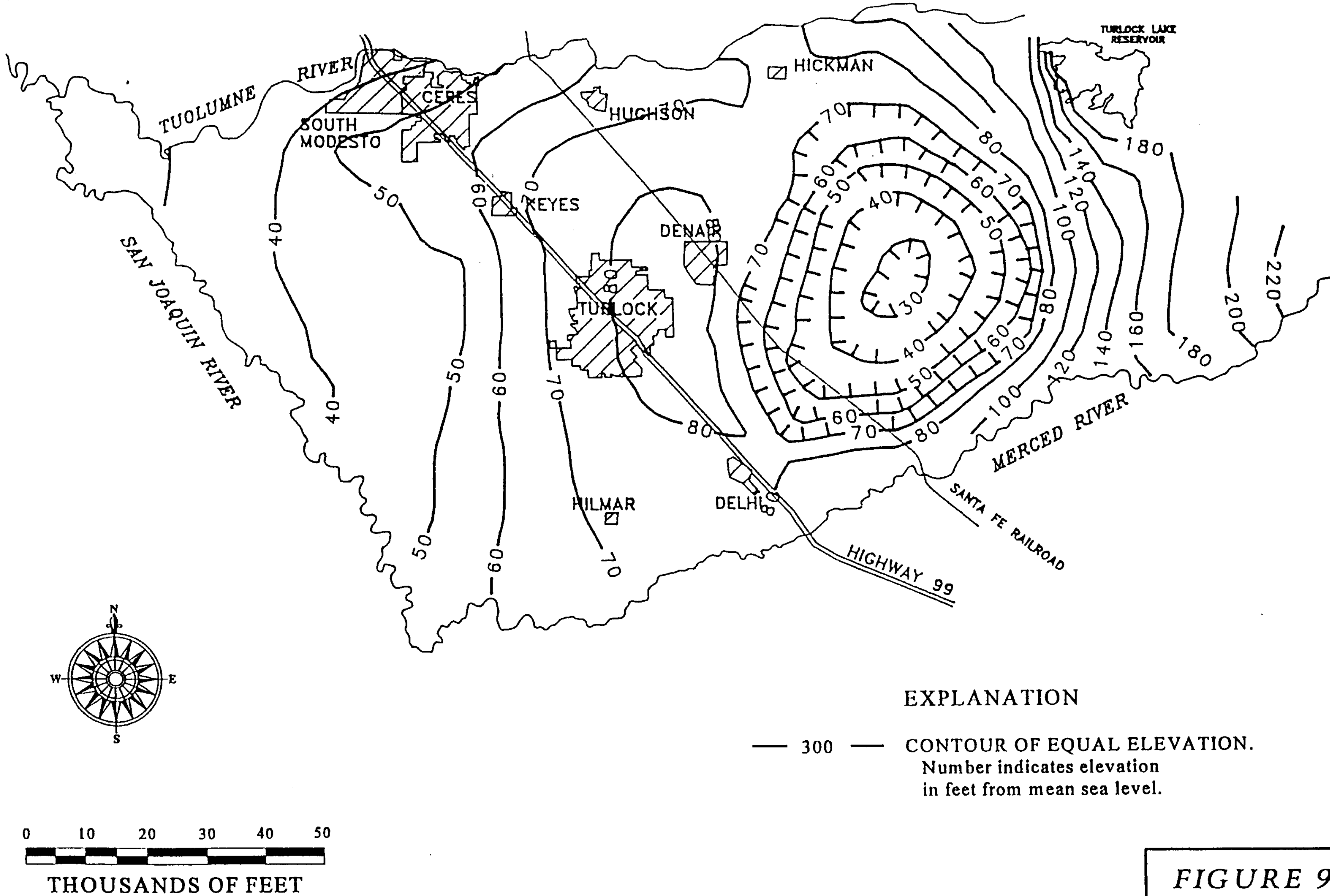


EXPLANATION

— 300 — CONTOUR OF EQUAL ELEVATION. Number indicates elevation in feet from mean sea level.

FIGURE 8

GROUNDWATER ELEVATIONS - FALL 1991

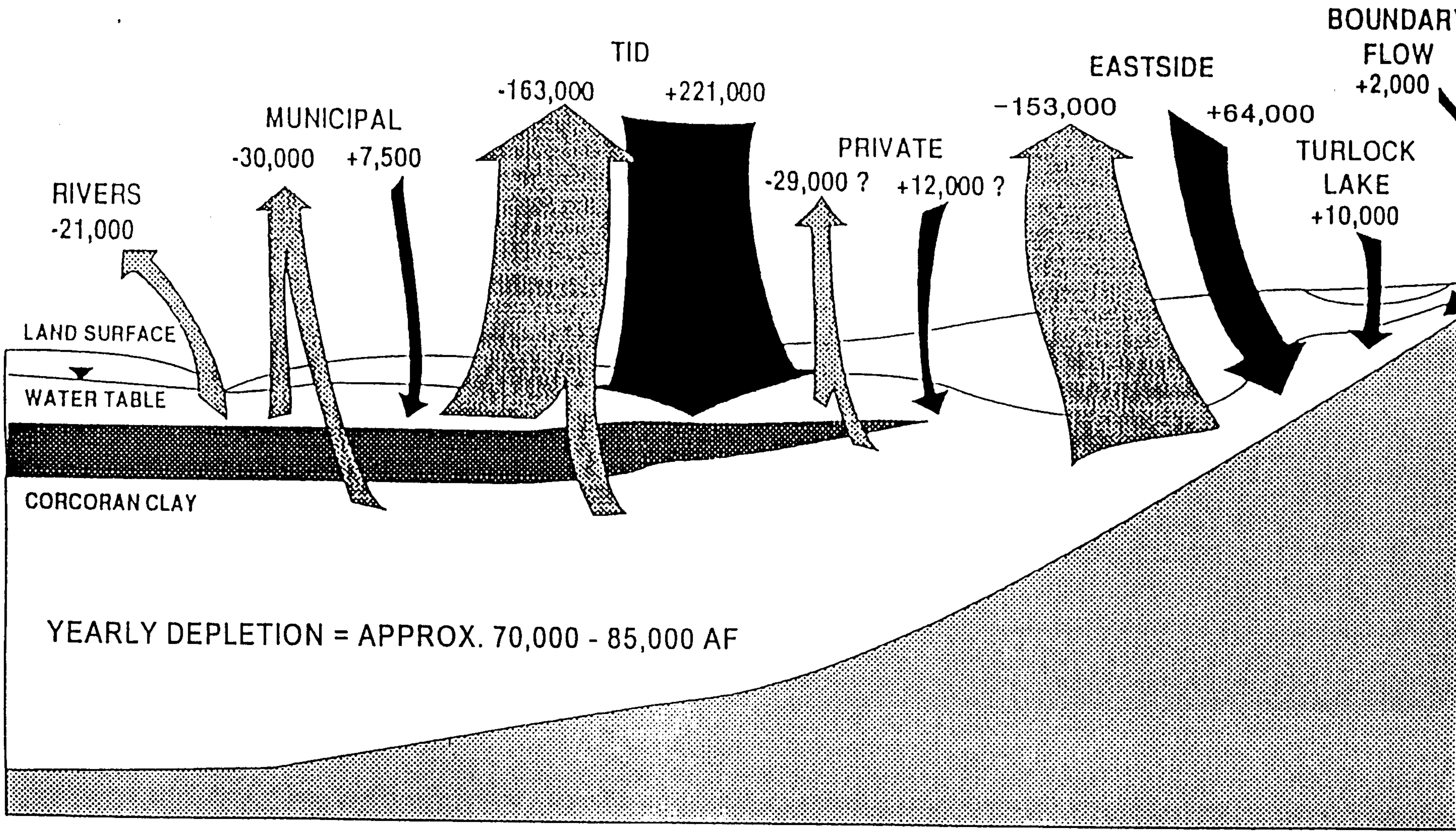


EXPLANATION

— 300 — CONTOUR OF EQUAL ELEVATION. Number indicates elevation in feet from mean sea level.

FIGURE 9

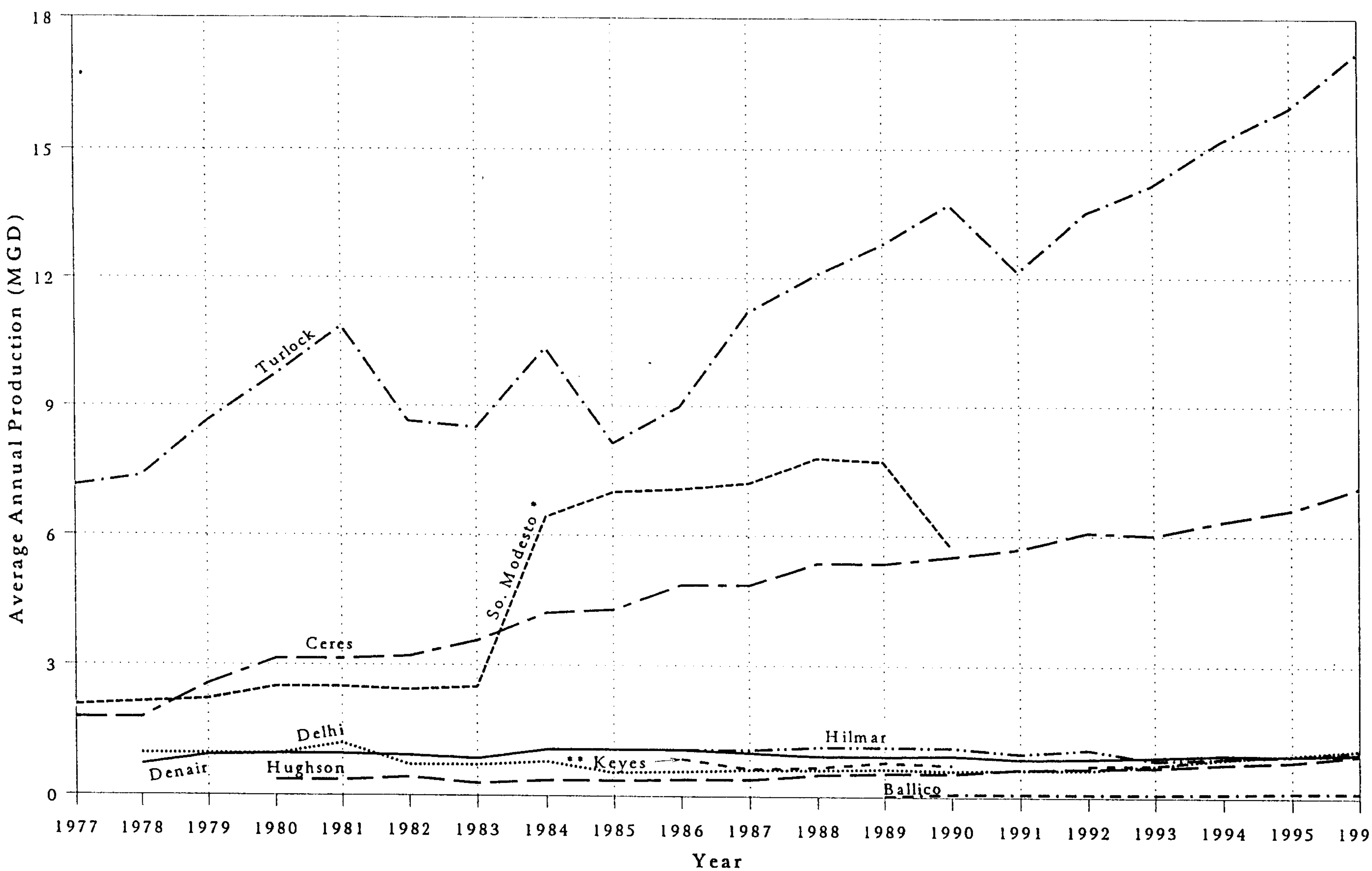
INFLOWS AND OUTFLOWS TO GROUNDWATER BASIN



NOTES: 1. Water quantities, representing amounts of water flowing into and out of the Basin, are in Acre-Feet per Year.
2. Information sources include: TID (Current Water Supply Conditions), 1989 and Eastside Water District (Irrigation Water Master Plan), 1990

FIGURE 10

HISTORIC MUNICIPAL WATER PRODUCTION



Notes: * So. Modesto includes both So. Modesto pumping from 1984 - 1990 and Del Este pumping from 1977 - 1996.

** Keyes Community Services District data from 1991 is unavailable at this time.

Source: Brown & Caldwell. 1992 (1977-1990), updated with data from the municipalities (1991-1996)

FIGURE 11

Appendix B

Tables

Table 1 **Average Annual Agricultural Water Usage**

Agency	Surface Water (acre-ft per yr.)	Surface Water Percentage	Groundwater (acre-ft per yr.)	Groundwater Percentage	Total (acre-ft per yr.)
Turlock Irrigation District (TID) *	435,000	80%	106,000	20%	541,000
Individual growers within TID **	0	0%	123,000	100%	123,000
Merced Irrigation District ******	22,000	100%	0	0%	22,000
Eastside Water District *****	0	0%	155,000	100%	155,000
Ballico-Cortez Water District *****	0	0%	27,000	100%	27,000
Individual Irrigators ****					
Municipal Waste Water Effluent ***	13,000	100%	0	0%	13,000
Total	470,000	53%	411,000	47%	881,000

Notes: * TID usage is based on a 1984-1996 average. Total usage equals the avg. SW & GW into the system minus the avg. spills to the river. Evaporation is minimal. The percentage of total usage to total system water was subtracted from the total GW & SW to calculate the GW & SW usage. (Note: Spills to the river from the TID canals vary from year to year and over the course of a season, depending on the type of year, irrigation & drainage requirements, etc.)

** Individual grower pumping is an estimate based on electrical usage.

*** Waste water effluent from the municipalities is utilized for agricultural purposes (see Table 5).

**** The individual irrigators refer to:

1. The irrigation water used for those areas outside of other agency boundaries. There is a fairly large area located on the eastern boundary of the Basin which could potentially be developed into agricultural farm land. The extent of the current development and water usage is unknown at this time.
2. The individual growers within both the Merced Irrigation District which use groundwater to supply their crop-water requirement.

***** With the exception of minor amounts of surface water made available from Turlock and Merced irrigation districts in wet years, irrigators within the Eastside and Ballico-Cortez water districts rely on groundwater to supply irrigation water.

****** Groundwater is used to supply approximately 4% of Merced ID's total deliveries, however, the wells used to supply that water are not located within the Turlock Groundwater Basin. Therefore, since the groundwater is not pumped from this Basin, Merced ID's deliveries within the Turlock Groundwater Basin are assumed to be 100% surface water.

Table 2 **Annual Groundwater Usage by Municipalities**

Agency		1995 Population	Annual Production (Million Gallons)	Annual Production Percentage	Per Capita Consumption (gpcd)
Ballico	**	375	28	0.18%	203
Ceres		31,243	2,410	15.70%	211
Delhi		4,500	360	2.35%	219
Denair		3,600	350	2.28%	266
Hilmar		5,000	350	2.28%	192
Hughson		3,589	301	1.96%	230
Keyes	**	3,900	351	2.29%	247
So. Modesto	*	17,300	1,835	11.96%	291
Stanislaus/Merced Co.	***	19,200	3,540	23.07%	500
Turlock		49,000	5,823	37.94%	326
Total		137,707	15,348	100.00%	305

Notes:

* Includes former Del Este Water Company
Population estimated by 5% increase/year = 17,300
based on 13,565 population in 1990

** Estimated

*** Represents small private residential water systems, commercial businesses, and industrial plants not served by the major utilities.
Estimated water use based on 500 gpd per person
Population based on Brown & Caldwell Phase 3 Report

Table 3 Municipal Monthly Flow Distribution

Month	Percent of Average
January	50
February	40
March	50
April	90
May	120
June	150
July	170
August	160
September	130
October	100
November	80
December	60

Source: Brown and Caldwell, Phase 3 Project Facilities Planning Draft Report, February 1992.

Table 4

Projected Municipal Annual Water Demand

	Annual Demand (MGD)		
Utility	1995	2005	2030
Ballico	0.1	0.2	0.3
Ceres	6.6	8.9	20.5
Delhi	1.0	1.3	3.1
Denair	1.0	1.3	2.8
Hilmar	1.0	1.3	3.0
Hughson	0.8	1.1	2.6
Keyes	1.0	1.3	2.9
So. Modesto	5.0	6.7	14.9
Turlock	16.0	21.1	47.3
Total	32.5	43.2	97.4

General Notes: 1995 figures are based on actual usage.

2005 & 2030 figures are estimated based on projected growth.

Not included in this projection are the small private residential water systems, commercial businesses and industrial plants not served by the major utilities.

Table 5 **Irrigation Water Salinity Tolerance for Crops**

Crop	Total Dissolved Solids in Water (ppm)
Bean	450
Onion	510
Almond	640
Pepper	640
Apricot	700
Peach	700
Walnut	700
Corn Silage	770
Spinach	830
Alfalfa	830
Cantaloupe	960
Tomato	1,100
Sudan Grass	1,200
Sorghum	1,700
Safflower	2,200
Wheat	2,600
Sugar Beet	3,000
Barley	3,400

Note: Salinity tolerances given represent allowable levels with no yield loss for crops grown within the Turlock area. (University of California Cooperative Extension, 1988)

Table 6

Treated Waste Water Effluent Usage & Disposal

Agency		Annual Totals (million gallons) Percolation Ponds	Agricultural Irrigation	Discharged to River	Other Uses	Total
Ballico	*					
Ceres	**	850.91			33.50	884.41
Delhi		182.50				182.50
Denair	***					
Hilmar	****	19.70	89.80			109.50
Hughson		182.50				182.50
Keyes	***					
Modesto	*****		3,751.00			3,751.00
Turlock			264.92	3,385.08		3,650.00
Total		1,235.61	4,105.72	3,385.08	33.50	8,759.91

General Note: 1 million gallons = 3.0689 acre-feet

Notes:

* Customers within the Ballico Community Services District use septic tank systems for waste water disposal.

** A portion of the City of Ceres treated waste water effluent is used by TID's Almond Power Plant. The amount of water used by the plant varies depending on how much the plant is utilized. It is estimated that the TID will pump an average of 67 million gallons per year to the plant, where it is further treated and used to create steam. However, about 50% of the water is later returned to the City of Ceres percolation ponds. Therefore, about 33.6 million gallons per year are consumed by the power plant.

*** Keyes and Denair community services districts both contract with the City of Turlock for waste water treatment and disposal. The waste water produced by these agency's is included in the City of Turlock's totals.

**** The Hilmar County Water District's breakdown of water uses is estimated.

***** The City of Modesto's total is metered effluent flows to agricultural land in the Turlock Basin. It includes effluent from areas both north and south of the Tuolumne River.

Appendix C

General Definitions

APPENDIX C - GENERAL DEFINITIONS

AB 3030 -	Assembly Bill 3030, the Groundwater Management Act (codified in California Water Code sections 10750 *et seq.*) was passed by the State legislature during the 1992 session, and became law on January 1, 1993.
Abandonment -	See "Well Abandonment"
AF/YR -	Acre-feet per year (conversion factor: 1,120 AF/YR = 1 MGD)
Association -	Refers to the "Turlock Groundwater Basin Association"
Aquifer -	A geologic formation that stores, transmits and yields significant quantities of water to wells and springs.
Basin -	See "Turlock Groundwater Basin"
CEQA -	California Environmental Quality Act
Conjunctive Use -	A term used to describe operation of a groundwater basin in coordination with a surface water reservoir system. The purpose is to artificially recharge the basin during years of above-average precipitation so that the water can be withdrawn during years of below-average precipitation, when surface supplies are below normal.
DBCP -	Dibromochloropropane
DOHS -	State Department of Health Services
DTSC -	California Department of Toxic Substances Control
DWR -	California Department of Water Resources
EDB -	Ethylene dibromide
EPA -	United States Environmental Protection Agency
GMP -	Groundwater Management Plan, developed under AB 3030.
GW -	Abbreviation for "groundwater"
Groundwater -	Subsurface water occurring in the zone of saturation.
High Groundwater -	Groundwater levels higher than 6 feet below ground level which can adversely impact crops. High groundwater can be caused by "perched" water, overall high groundwater conditions, or other factors.

ID -	Irrigation District
Inactive Wells -	An unused well that the owner demonstrates his intention to use the well again. The California Water Well Standards (Bulletins 74-81 & 74-90) includes specific guidelines for things the owner must do to show evidence of his intention to continued to use the well.
Local county environmental health agencies -	Merced County Division of Environmental Health and the Stanislaus County Department of Environmental Resources
MCL -	Maximum Contaminant Levels
Merced ID -	Merced Irrigation District
MGD -	Million gallons per day (conversion factor: 1 MGD = 1,120 AF/YR)
μg/l -	Micrograms per liter (approximately equal to ppb)
mg/l -	Milligrams per liter (approximately equal to ppm)
Overdraft -	The condition of a groundwater basin where the amount of water withdrawn from an aquifer or groundwater basin exceeds the amount of water replenishing the basin (net recharge) over a period of time.
Participating Agency -	Any local agency within the Turlock Groundwater Basin which adopts this AB 3030 groundwater management plan.
PCE -	Perchloroethylene
ppb -	Parts per billion (approximately equal to μg/l)
ppm -	Parts per million (approximately equal to mg/l)
Public Water System -	See Appendix D, entitled: "PUBLIC WATER SYSTEM DEFINITIONS"
Recharge -	Flow to groundwater storage from precipitation, infiltration from streams, and other sources of water.
Reducing Conditions -	A lack of oxygen in the groundwater.
RWQCB -	Regional Water Quality Control Board

Safe Yield -	The maximum quantity of water that can be continuously withdrawn from a groundwater basin without adverse effect.
Saline -	Consisting of or containing salts, the most common of which are potassium, sodium, or magnesium in combination with chloride, nitrate, or carbonate.
SCADA -	Supervisory Control and Data Acquisition - a type of remote monitoring and control system.
SW -	Abbreviation for "surface water"
TCE -	Trichloroethylene
TDS -	"Total dissolved-solids," the quantity of minerals (salts) in solution in water, usually expressed in milligrams per liter (mg/l) or parts per million (ppm).
TGBA -	Turlock Groundwater Basin Association
TID -	Turlock Irrigation District
Turlock Groundwater Basin -	A groundwater system located on the eastern side of the San Joaquin Valley bounded by the Tuolumne River on the north, the Merced River on the south, the San Joaquin River on the west, and the Sierra Nevada foothills (specifically the western extent of the low-permeability Valley Springs rock formation) on the east.
Unused Wells -	Wells that are not being used are considered "unused." Wells that are not used for a period of one year are considered "abandoned," unless the owner demonstrates his intention to use the well again. (see "Inactive Wells")
USGS -	United States Geological Survey
UST -	Underground storage tanks
VOC -	Volatile organic compound
Well Abandonment -	According to the California State Well Standards *"a well is considered "abandoned"... if it has not been used for one year, unless the owner demonstrates intention to use the well again..."* All "abandoned" wells must be properly destroyed. (see "Well Destruction")

Well Destruction - All "abandoned" wells (see "Well Abandonment") and exploration or test holes must be properly destroyed. The objective of well destruction is to restore subsurface conditions as nearly as possible to the conditions that existed before the well was constructed, taking into consideration any changes which may have occurred since the time of construction. Each of the counties and some of the cities within the Basin have established well standards which specify well destruction requirements.

WPA - Wellhead Protection Area defined by the Safe Drinking Water Act Amendments of 1986 as *"the surface and subsurface area surrounding a water well or well field supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water or well field."*

WPP - Federal Wellhead Protection Program established by Section 1428 of the Safe Drinking Water Act Amendments of 1986. They are designed to protect groundwater resources of public drinking water from contamination to minimize the need for costly treatment to meet drinking water standards.

Appendix D

Public Water System Definitions

APPENDIX D - PUBLIC WATER SYSTEM DEFINITIONS

Public Water System definitions.

(CALIFORNIA HEALTH & SAFETY CODE, DIVISION 5. SANITATION PART 1. SANITARY PROVISIONS, CHAPTER 7. CALIFORNIA SAFE DRINKING WATER ACT Section 4010.1. Definitions)

(h) "Public water system" means a system for the provision of piped water to the public for human consumption that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. A public water system includes the following:

(1) Any collection, treatment, storage, and distribution facilities under control of the operator of the system which are used primarily in connection with the system.

(2) Any collection or pretreatment storage facilities not under the control of the operator that are used primarily in connection with the system.

(3) Any water system that treats water on behalf of one or more public water systems for the purpose of rendering it safe for human consumption.

(i) "Community water system" means a public water system that serves at least 15 service connections used by yearlong residents or regularly serves at least 25 year long residents.

(j) "Noncommunity water system" means a public water system that meets one of the following criteria:

(1) Serves drinking water to at least 25 nonresident individuals daily at least 60 days of the year, but not more than 24 yearlong residents.

(2) Serves 15 or more service connections and any number of nonresident individuals at least 60 days of the year, but no yearlong residents.

(m) "State small water system" means a system for the provision of piped water to the public for human consumption that serves at least five, but not more than 14, service connections and does not regularly serve drinking water to more than an average of 25 individuals daily for more than 60 days out of the year.

Nontransient-noncommunity Water System. (TITLE 22, CHAPTER 15. DOMESTIC WATER QUALITY AND MONITORING, ARTICLE 1. DEFINITIONS, Section 64400.80):

"Nontransient-noncommunity water system": means a public water system that is not a community water system and that regularly serves at least the same 25 persons over 6 months per year.

Transient-noncommunity Water System. (TITLE 22, CHAPTER 15. DOMESTIC WATER QUALITY AND MONITORING, ARTICLE 1. DEFINITIONS, Section 64401.85):

"Transient-noncommunity water system" means a public water system that is not a community water system or a nontransient-noncommunity water system.

Appendix E

Memorandum of Understanding

July 14, 1995

MEMORANDUM OF UNDERSTANDING RELATING TO THE FORMATION AND OPERATION OF THE TURLOCK GROUNDWATER BASIN ASSOCIATION

1. PARTIES:

The Parties to this Memorandum of Understanding ("MOU") are: Del Este Water Company, a California corporation; City of Ceres, a California Public Agency; Keyes Community Services District, a California Public Services District; Denair Community Services District, a California Public Services District; City of Turlock, a California public agency; Hilmar County Water District, a California Public Service District; Delhi County Water District, a California Public Services District; City of Hughson, a California public agency; City of Modesto, a California public agency; Merced Irrigation District, a California Irrigation District; Ballico Community Services District, a California Public Services District; County of Merced, a Political Subdivision of the State of California; County of Stanislaus, a Political Subdivision of the State of California; Eastside Water District, a California Water District; Ballico-Cortez Water District, a California Water District; and Turlock Irrigation District, a California Irrigation District .

2. RECITALS:

This MOU is entered into with regard to the following facts and circumstances, among others:

2.1 Groundwater and surface water resources within the Turlock Groundwater Basin are vitally important resources, in that they provide the foundation to maintain current and fulfill future environmental, agricultural, domestic, municipal and industrial needs, as well as other needs, and to maintain the economic viability and prosperity of the Basin area.

2.2 The Stanislaus/Merced County area is one of the world's foremost agricultural areas; and the agricultural industry has played a major role in the development of the economy of Stanislaus/Merced County area. In an era of increasing competition for the area's finite water resources, it is important to understand and plan for the utilization of all the area's water resources in order to preserve all elements of the local economy vital to the area's well-being.

2.3 The Parties desire to form an association, which will be known as the Turlock Groundwater Basin Association, to provide a mechanism for the Parties to cooperate in working toward the purposes and goals established in this MOU.

2.4 Purposes and Goals: The purposes and goals for the formation of the Association are:

2.4.1 To determine and evaluate the Basin's existing groundwater supplies;

2.4.2 Prepare and promote a draft groundwater management plan for the Basin, which could be adopted by the appropriate agency or agencies;

2.4.3 Consider developing and/or utilizing an existing hydrologic groundwater model of the Basin's groundwater supplies;

2.4.4 Determine the Basin's need for additional or improved water extraction, storage, delivery, conservation, reuse and recharge facilities; and

2.4.5 Provide information and guidance for the management, preservation, protection and enhancement of the Basin.

2.5 The Parties believe that non-coordinated action by water providers and users within the Basin could result in counter productive competition for finite resources resulting in adverse impacts to the groundwater and surface water supplies within the Basin.

2.6 The Parties believe that a mutually acceptable groundwater management plan for water suppliers and water users within the Basin is important to protect the groundwater and surface water resources and will assist in meeting the needs of all users of such resources within the Basin.

2.7 Because of the enactment of State legislation, it is now clear to the Parties that local management of water resources is desirable in order that local control be maintained over such resources.

2.8 The Parties hereto desire to enter into this MOU in order to form an association to promote certain goals and provide coordinated planning to make the best use of available water resources to meet the needs of their respective constituents and service territories in the mutual best interests of the inhabitants and resources of the Basin.

2.9 In forming the Association, it is the Parties' desire that the Association not be formed as a separate governmental entity, nor have any enforceable regulatory authority over any Party's facilities or any Party's respective surface water or groundwater supplies or rights, nor duplicate any services, duties or authority of any other agency.

3. <u>AGREEMENT:</u>

The Parties agree as follows:

4. <u>DEFINITIONS:</u>

The following terms, whether in the singular or the plural, and when used herein with initial capitalization, shall have the meanings specified in this Section 4:

4.1 **Basin:** The Turlock Groundwater Basin, which is geographically defined as that area in the State of California bounded on the west by the San Joaquin River; on the north by the Tuolumne River, on the east by the base of the Sierra Nevada foothills; and on the south by the Merced River, and includes the area of land overlying that basin and all tributaries therein.

4.2 **Board:** That body, consisting of one representative from each of the Parties, which governs the Association, as established pursuant to Section 5.2 of this MOU.

4.3 **Chairperson:** The presiding officer of the Association as elected by the Board. In the absence of the Chairperson, the Vice-Chairperson will perform all duties of the Chairperson.

4.4 **Governing Bodies:** The legislative bodies of the governmental Parties to this MOU, and the Boards of Directors of the privately owned Parties to this MOU.

4.5 **MOU:** This Memorandum of Understanding Relating to the Formation and Operation of the Turlock Groundwater Basin Association.

4.6 **Parties:** Each of those entities named in Section 1 of this MOU, or those Parties added pursuant to Section 5.4 of this MOU.

5. THE ASSOCIATION:

5.1 **Powers and Purposes:** The Parties to this MOU hereby form the Turlock Groundwater Basin Association.

5.1.1 The purpose of the Association is to provide a forum in which the Parties can work cooperatively; to combine the available talent of the Parties' respective staffs; and to accomplish the purposes described in Section 2 of this MOU.

5.1.2 This Association shall have no enforceable regulatory authority over any person or entity, including Parties or Parties' facilities or rights.

5.2 **Board:** The Association shall be governed by a Board whose membership, duties and responsibilities are set forth herein.

5.2.1 Each Party shall designate one person to serve as a member of the Board, and one or more alternates and notify the Chairperson of those appointments. Each member of the Board, and each alternate, shall serve at the pleasure of the Party appointing such member. A Party's alternate may serve in the place of that Party's member in the absence of such member and, in such case, the alternate shall have the powers of the member.